Environment Switzerland 2015

Report of the Federal Council

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Environment Switzerland 2015

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Foreword

We can only implement far-sighted environmental policy if we know how things stand with our environment. ‘Traditional’ knowledge alone – for example about the risks associated with polluted air or water, or about the dangers of climate change – is no longer sufficient. The challenges have changed. Today, we are consuming too many natural resources. Yet the available supply of raw materials and soil is finite. As a result, habitats are being destroyed and animal and plant species are being displaced. Such correlations require information and clarification.

Up to now, the federal authority with responsibility for this area carried out regular surveys of the state of the environment in Switzerland. With the ratification of the Aarhus Convention, our country undertook to present a national report on the state of the environment at least every four years. With “Environment Switzerland 2015”, the Federal Council fulfils this obligation for the first time. The report provides an overview of the state of the environment and natural resources. It demonstrates how our way of life and economic activities affect the environment, the measures that have been taken to counteract these impacts, and the areas in which action is required.

Switzerland has some successes to report in this regard. Rivers, lakes and the air are cleaner and the forests are less polluted than they were a few years ago. We have not yet fulfilled our goals in other areas, however. For example, the amount of land being consumed by built-up area and transport continues to increase, biodiversity is declining despite the measures taken, and the spreading of fertilisers and nitrogen inputs in agriculture are still

causing soil pollution. Therefore we must not rest on our laurels – particularly in view of the fact that consumption and prosperity continue to grow. The associated environmental impacts are increasing accordingly.

From the perspective of the Federal Council, environmental policy will focus on three key areas in the years to come: climate protection, the conservation of biodiversity and the management of natural resources. To be efficient and internationally competitive in the long term, an economy must conserve resources. Moreover, the Federal Council will pay greater attention in future to the implementation of existing laws in cooperation with the cantons, and foster dialogue about the value of the environment with the population.

To achieve these objectives, we need to understand the situation. Understanding is achieved through facts. This report presents the facts.

Federal Councillor Doris Leuthard

Anita Vozza

Overview

The "Environment Switzerland 2015" report provides an overview of the current state and development of the environment in our country. It assesses the measures implemented by the federal authorities to improve the quality of the environment and identifies areas in which further action is required. It also compares the progress achieved in Switzerland with that in neighbouring countries, and looks to the future by summarising the environmental outlook for the year 2030.

Thanks to the environmental policy measures of recent decades, the state of the environment in Switzerland has improved in many respects. Environmental pollution has declined in many areas. Air quality has improved steadily since the mid-1980s and water quality is generally good.

However, if all countries were to use as many resources as Switzerland, around 2.8 Earths would be needed to meet the resulting demand. Switzerland's resource consumption exceeds the level that can be sustained by nature – particularly when its global impacts are taken into account. Due to its patterns of economic and consumption activity, Switzerland is contributing more and more to the overexploitation of natural resources and ecosystems, not only at home but also abroad. A growing proportion of the environmental impacts caused by the consumption activities of the Swiss population arise in other countries; indeed, these impacts now far exceed those generated at home. Nonetheless, the environmental policy measures implemented over the last 20 years and technical progress have contributed to the greater general efficiency of energy and raw material use by the Swiss economy. At the same time, however, consumption has increased: this is evidenced, for example, by the fact that the volume of municipal solid waste, including recycled material, increased at twice the rate of the Swiss population since 1990. Per capita domestic greenhouse gas emissions have declined considerably since 1990; however, if the emissions generated abroad by imported goods are included in the calculations, per capita emissions have actually increased. Mobility as well as settlement and urban areas are also growing faster than the population.

Despite the progress made at domestic level, natural resources are also under pressure in Switzerland. The major factors influencing this trend are climate change due to greenhouse gas emissions, increasing land use for built-up areas and transport, unsuitable spatial planning, inputs of nitrogen, fertilisers and plant protection products from agriculture, and nitrogen oxide and particulate matter emissions from transport, industry and commerce (the table in Chapter 18 provides an overview of the main pollution types). As a result, biodiversity in Switzerland is in a poor state and the loss of fertile soil continues unabated. Landscapes are also declining in quality.

The current state of the environment in Switzerland not only has negative consequences for the natural ecosystems, it also has negative impacts on people. Although significant progress has been made in protecting health against environmental impacts, the harmful effects of particulate matter, ozone and noise remain too high. For example, every fifth resident in Switzerland is affected by excessive road traffic noise during the day, and between 2,000 and 3,000 people die prematurely each year due to the effects of air pollution. If ecosystems, for example forests, come under pressure, they also reduce the services they provide for people (e.g. avalanche and flood protection, clean drinking water, recreation etc.). This affects people's well-being, in turn, and can result in the generation of considerable financial costs (see table of impacts in Chapter 19).

At global level, climate change, the state and availability of water, the loss of biodiversity,

and environmental damage caused by nitrogen compounds are among the most challenging environmental problems of the 21st century. The effect of climate change on Switzerland is expected to be above average. Both positive (e.g. for agriculture and energy consumption) and negative (e.g. regarding natural hazards and biodiversity) impacts may be expected by 2030. The negative consequences are likely to clearly outweigh the positive ones in the long term.

The prospects for Switzerland in relation to water are comparatively favourable. Despite local bottlenecks, the country will continue to have a sufficient water supply in the future. As a country that imports agricultural and industrial products, however, Switzerland is also dependent on the global management of this resource. The pollution of waters with trace substances – like drug residues and cleaning products – will decline once the country's major treatment plants have been upgraded. Nevertheless, diffuse inputs of micropollutants from run-off containing pesticides and other endocrine disrupters remain a problem. Thanks to the rehabilitation of watercourses and upgrading of existing hydropower plants, the ecologically poor state of water bodies is expected to improve by 2030. However, additional negative impacts could arise as a result of the planned expansion of hydropower generation.

Unlike in the case of climate change, Switzerland appears to be largely capable of controlling future developments in relation to the changes in biodiversity. The state of the open land, forests and water bodies is mainly influenced by the use of land by agriculture, forestry and water management. In densely populated Switzerland, the development of biodiversity is also highly dependent on whether the country succeeds in developing ecological infrastructure consisting of protected and connected areas, and in upgrading the urban agglomerations so that the state of biodiversity in built-up areas also improves.

Link types (PDF)

At the end of chapter

 Environmental state, Maps

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→ *infobox* — Link to a infobox
www.bafu.ch — Link to a website
→ *FOEN 2014a* — Link to the bibliography

Evaluation tool

State and trend

 positive

 negative

 neutral

 impossible to evaluate

Introduction

"The Federal Council shall assess the state of the environment in Switzerland at least every four years and shall submit a report on the results to the Federal Assembly." This sentence was added to Switzerland's Environmental Protection Act (EPA) in June 2014 due to the ratification of the Aarhus Convention. The report "Environment Switzerland 2015" is the first environment report which fulfils the EPA's renewed mandate regarding the provision of information. It is based on a long tradition of environment reports which were generally published up to now by the Federal Office for the Environment (FOEN). The "Environment Switzerland 2015" report provides objective and factual information about the state of the environment and environmental pollution. With this report, the Federal Council publishes a substantiated overview which is intended to provide an important basis for the future design of environmental policy and for other environment-relevant policy areas.

Structure of the report

The "Environment Switzerland 2015" report is divided into three parts: "Stocktaking of environmental policy implementation" (Part I), "State of the environment" (Part II) and "Trends and outlook" (Part III). This ninth report contains an assessment of Swiss environmental policy, and its target readership includes both decision-makers and members of the general public with an interest in environmental issues. More detailed information, for example about the data and indicators used in this report, is provided via internet links.

Conceptual framework and methodological principles

The approach taken in this edition of "Environment Switzerland" is similar to that adopted in the 2007, 2009, 2011 and 2013 editions of the report, which, in turn, were based on the standardised European DPSIR model.[1] Thus, in addition to 'pure' environmental topics, the report also explores the main human activities that influence the environment.

Experts from the Swiss federal administration were involved in the selection of the indicators and compilation of the texts.

Evaluation method

The indicators contained in the report demonstrate the state and development of the environment for each topic. Where possible, the assessments were depicted using coloured triangles. This means that the main information can be identified at a glance. The assessments were carried out by the relevant experts based on their knowledge of the topic in question. If politically defined targets (target values, limit values etc.) exist, these form the basis of the assessment. The explanations are provided beside the assessments and illustrated by the associated diagrams.

The diagrams presented in the report are generally based on data available up to October 2014.

Illustrations

This edition of the environment report is illustrated for the first time by a photographer. The photographs provide a different perspective on environmental topics, which supplements the texts and diagrams and illustrates visual points of contact and intersection in the sometimes problematic interaction between man and nature.

1 DPSIR: Driving forces, Pressures, State, Impacts, Responses.

I Stocktaking of environmental policy implementation

In this overview, the Federal Council reports on the implementation of Swiss environmental policy. It examines the effects of environmental policy in the light of the objectives and targets enshrined in legislation and defined in action plans and strategies so that answers to the following questions can be provided for each of the topics examined:

→ Where does Swiss environmental policy stand today?
→ Where is action required?

The summary presentation provides an initial impression of the state of the environment and the effectiveness of the measures taken to date. Under the heading “Action required”, current and upcoming tasks are addressed, and the environmental issues that require action from the perspective of the Federal Council are identified. The associated conditions (e.g. national and international legislation and obligations) must be taken into consideration here. The key messages are backed by relevant indicators which evaluate whether the defined targets have been attained. Part II of the report provides more in-depth insights into the various topics.

The following topics are discussed here: Natural resources – Climate – Biodiversity – Air – Water – Soil – Landscape – Forest – Natural hazards – Noise – Electrosmog – Waste – Contaminated sites – Major accident risks – Chemicals – Biotechnology – International cooperation.

Natural resources

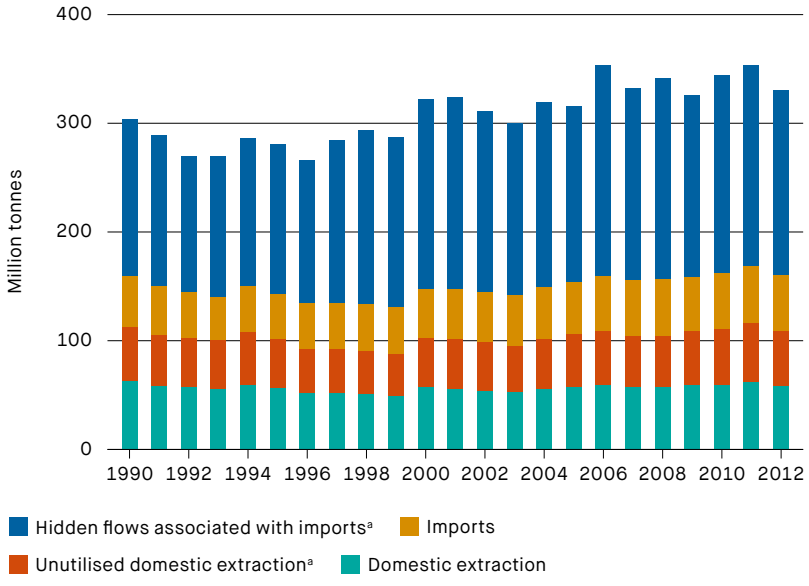
Natural resources are essential to the well-being of our society. If resources like water, soil, clean air and biodiversity and minerals, such as energy raw materials and metals, are no longer available in sufficient quantities and quality, this poses a threat to the economic system and quality of life of ordinary people.

Switzerland contributes to the pressure on natural resources and ecosystems, not only at a domestic level but also globally. It is particularly important for an open economy like that of Switzerland to take all the upstream chains of resource consumption into account. Switzerland's domestic consumption is dependent on products which involve the use of resources abroad. Therefore much of the environmental impact of domestic consumption is caused abroad. On the other hand, thanks to technical progress and environmental measures, Switzerland is becoming more and more efficient in its use of energy and raw materials, and both the economy and population here are growing faster than material consumption. Overall, however, the environmental impact that Switzerland generates remains excessive.

Action required

Switzerland's current patterns of production and consumption must become more efficient and place fewer demands on resources. Action is required, in particular, to improve the ecological compatibility of consumption (e.g. through agreements), to recover valuable materials and substances (e.g. plastics, phosphorous), and to provide information on resource conservation and efficiency. For this reason, the Federal Council passed the Green Economy Action Plan on 8 March 2013. In addition, on 12 February 2014 it mandated parliament to revise the Environmental Protection Act as an indirect counter-proposal to the Green Economy popular initiative.

G I.1 Total Material Requirement (TMR)



[a] Estimate.
Source: FSO

State: negative

In 2012, 3.3 times more materials were utilised in other countries for the manufacture and transport of imports into Switzerland than accounted for by the imports themselves. The material requirement abroad is also increasing at a greater rate than the imports themselves.

Trend: negative

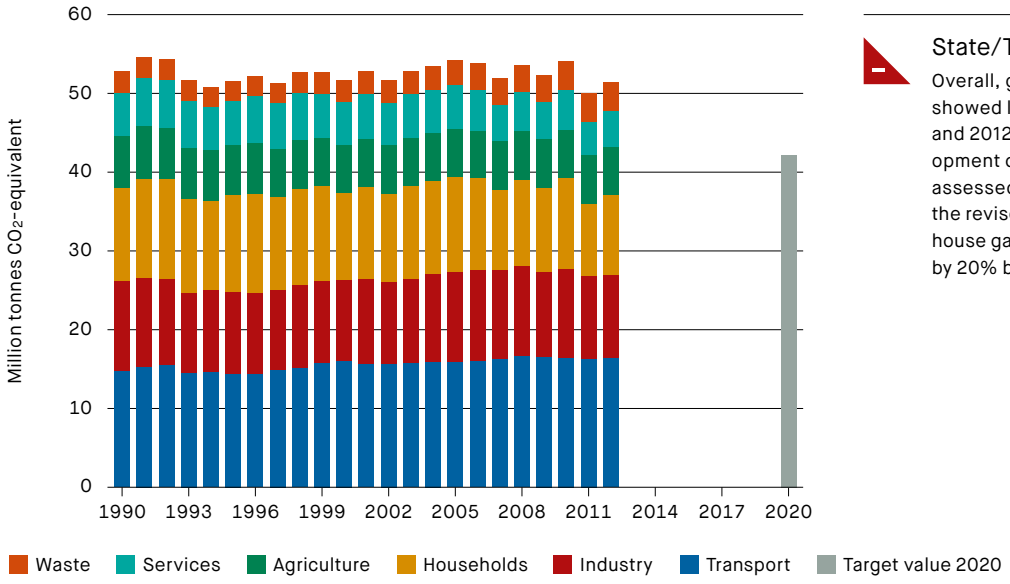
Between 1990 and 2012 the material requirement abroad increased by around 27% while the increase in imports over the same period was 11%. This increase is partly accounted for by the fact that greater numbers of finished products are now imported.

Temperatures in Switzerland continue to rise. However, no clear change in precipitation levels can be identified at present. The first commitment period of the Kyoto Protocol expired at the end of 2012, with Switzerland complying successfully with its Kyoto commitment. This was achieved in three ways: by implementing domestic measures, by purchasing emission reduction certificates from abroad, and through the effects of Swiss forests as a CO_2 sink. The new climate-policy objectives and measures for the period 2013 to 2020 are set out in the revised CO_2 Act, which came into force on 1 January 2013. As the intermediate emissions reduction target set in the CO_2 Act for the consumption of fossil heating fuels was not met, as stipulated in the Act, the CO_2 levy on these emissions was increased from CHF 36 to CHF 60 per tonne of CO_2 from the beginning of 2014. The climate change adaptation strategy has been developed into an action plan, which was adopted by the Federal Council on 9 April 2014.

Action required

The new CO_2 Act aims to contribute to limiting global warming to less than 2°C. This presents a challenge in various policy areas. The considerable potential that exists for reducing emissions from buildings and in the transport sector must be tapped.

G I.2 Development of greenhouse gas emissions by sector



State/Trend: negative

Overall, greenhouse gas emissions showed little change between 1990 and 2012. Therefore the state and development of the indicators should be assessed as negative as, according to the revised CO_2 Act, domestic greenhouse gas emissions must be reduced by 20% by 2020 compared to 1990.

The reference value according to "Switzerland's Initial Report – Update following the UNFCCC Review", 2007, is applicable for 1990.
Source: FOEN

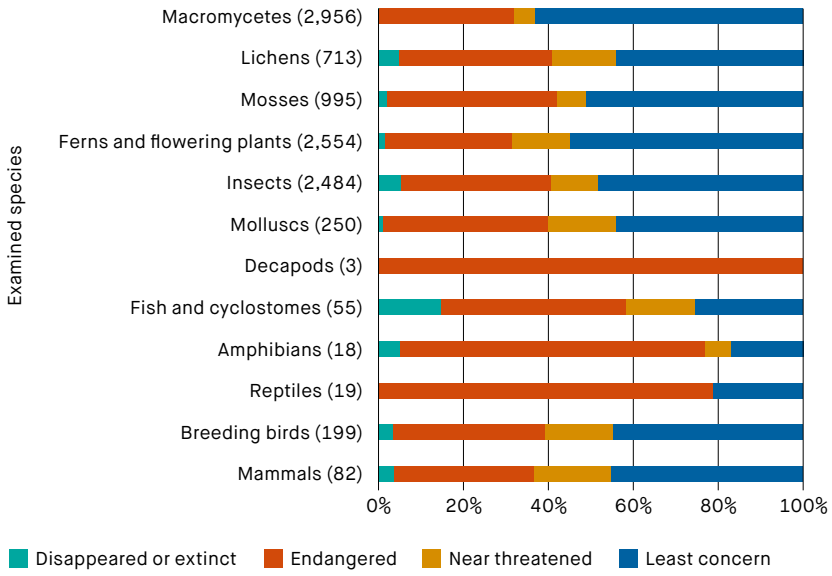
Biodiversity

Switzerland's biodiversity is in a poor state: this is clear from the substantial reduction in the area occupied by valuable habitats (alluvial sites, mires, dry meadows and pastures) and the high numbers of endangered animal, plant, lichen and fungus species. The decline in species populations has been accompanied by a loss of genetic diversity. The main causes are intensive agriculture, the channelling and use of water bodies for generating electricity, soil sealing, landscape fragmentation, and the spread of invasive alien species. The loss of biodiversity poses a risk to ecosystem services such as pure air, clean drinking water, soil fertility, and the pollination of crops and wild plants. A cross-sectoral approach is required to preserve biodiversity and the ecosystem services it provides. The Action Plan for the Swiss Biodiversity Strategy, which is due to be adopted by the Federal Council in 2015, aims to implement the objectives defined in the Strategy. It was developed through a process involving all of the relevant sectors of the administration, politics, business and science, and interest groups.

Action required

The economic impacts of the medium and long-term loss of and damage to biodiversity are still underestimated in sectoral policy decision-making processes. For this reason, the Swiss Biodiversity Strategy Action Plan includes measures which ensure that greater consideration is given to the services provided by biodiversity. For example, the expansion of hydropower as part of the Energy Strategy 2050 must take valuable water bodies into consideration. Further reductions must be made in pollutant loads (in particular ammonia and plant protection products), and sufficient land should be made available for habitats.

G I.3 Extinct, endangered, near threatened and least concern species, per group



Status from 1994 to 2012, by species group.
Source: FOEN

State: negative

36% of the evaluated species are threatened and 10% are potentially threatened. In other words, almost half of the indigenous species are at risk of extinction to a greater or lesser extent.

Trend: negative

Only a few of the examined groups could be evaluated a second time for the purpose of comparison. However, the results for the groups that have undergone revision show that the objective of reducing the number of threatened species by 1% per year has clearly not been attained.

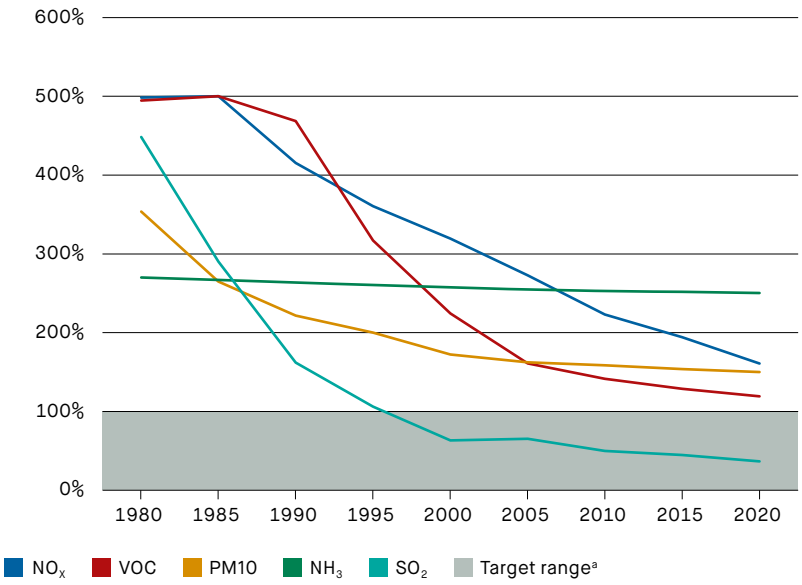
Air

The air in Switzerland has become considerably cleaner over the last 25 years. However, pollution from respirable particulate matter (PM10), ozone (O_3) and nitrogen oxides (NO_X) continues to exceed the legally prescribed ambient limit values. Some 2–3,000 people still die prematurely every year due to air pollution, and the associated health costs are estimated at over CHF 4 billion per year. These costs are generated by diseases of the cardiovascular and respiratory systems and by cancer. The ozone concentrations exceed the limit values because excessive amounts of volatile organic compounds (VOC) and nitrogen oxides are being emitted. Nitrogen inputs from ammonia (NH_3) and nitrogen oxides damage the soil, impair water quality, destabilise forests and have a negative impact on biodiversity. The main sources of the air pollution that still occurs today are motorised transport (NO_X, PM10), wood combustion (PM10), agriculture (NH_3, PM10), and industry (VOC, NO_X, PM10).

Action required

Further reductions must be made in emissions of particulate matter, nitrogen oxides, volatile organic compounds, and ammonia. Switzerland aims to consistently promote and use the best available technology in motor vehicles, agricultural and industrial facilities, and heating systems.

GI.4 Air pollutant emissions



[a] Emissions range, in which only precautionary measures are required.
Source: FOEN

State: negative
High emissions of nitrogen oxides (NO_X), volatile organic compounds (VOC), respirable particulate matter (PM10) and ammonia (NH_3) are still causing diseases of the respiratory and cardiovascular systems and increased mortality. They also contribute to the over-fertilisation of ecosystems.

Trend: positive
Thanks to the measures taken, considerable reductions in air pollutant emissions could be achieved over the past 25 years.

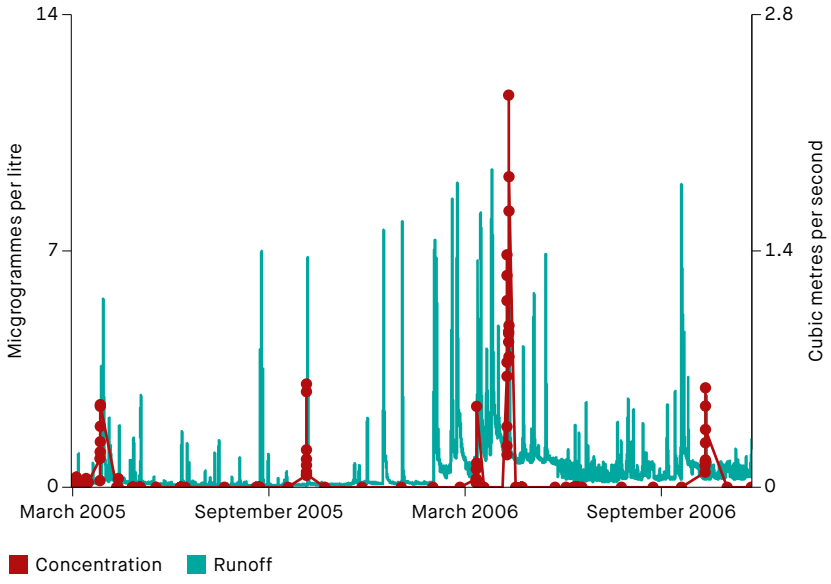
Water quality in Switzerland is generally good. At present, water bodies are mainly polluted by inputs of agrochemicals like fertilisers and plant protection products. Thanks to the construction of wastewater treatment plants (WTPs), which began 50 years ago, Switzerland has been able to reduce the pollution of rivers and lakes with phosphorous and nitrogen considerably. The future introduction of an additional treatment stage should also eliminate a broad spectrum of micropollutants. The Swiss parliament has approved the targeted upgrading of around 100 WTPs.

Due to hydraulic engineering structures and artificial barriers, the ecological condition of the structure of one quarter of watercourses is poor; approximately one quarter of these watercourses need to be rehabilitated. The operation of hydropower stations results in insufficient residual water volumes in the watercourses in many locations, and impairs the natural functions of the waters through hydropeaking and the strong alternation between surge and low flow.

Action required

The Federal Council is currently assessing the development of an action plan for the risk minimisation and sustainable use of plant protection products. The focus here is on the release of plant protection products into water bodies. The revised Water Protection Act of 2011 promotes the rehabilitation of rivers and lakes. It obliges the cantons to develop strategic plans for rehabilitation. Most of these plans had been completed by 2014. As not all cantons have complied with the deadlines specified in the legislation in the area of residual water remediation, the measures have been delayed by some years.

G I.5 Concentration of plant protection products in the Seebach stream (Lyss, Bern) 2005/2006



State: negative
In the short term, contamination from micropollutants is very high in small streams (around 100-times higher than the value stipulated in the Waters Protection Ordinance).

Trend: positive
The federal authorities are developing measures for the reduction of substance inputs by agriculture, inter alia through the development of an action plan for the minimisation of risk in the use of plant protection products.

Source: Canton of Bern, AWA

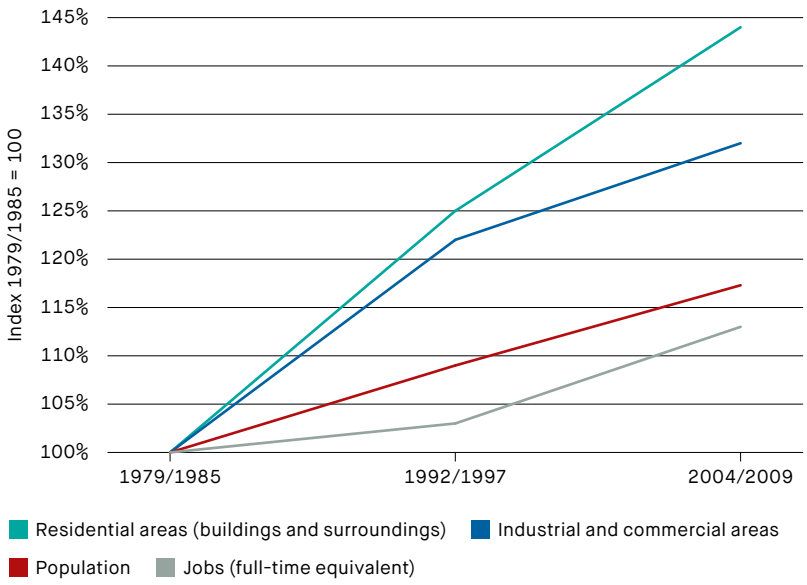
Soil

The loss of fertile land through the construction of built-up areas, leisure facilities, roads and other infrastructure has continued unabated in Switzerland for decades. As a result, 0.7m² of productive agricultural land was lost every second in the period 1979/1985 to 2004/2009. Considerable differences arise according to the region and type of land use involved. Settlement and urban areas are growing most markedly in rural areas. An additional 0.4m² of productive agricultural land per second was converted into forest (trees and shrubs) as less land is being used as meadow and pasture in mountain regions. Progress has been made in reducing the pollutant contamination of soil. This is due to a decline in air pollutant emissions and stricter regulations on the use of fertilisers and plant protection products. Areas in which farm manure from intensive livestock production is spread constitute an exception: copper and zinc levels in the soil continue to rise.

Action required

The efforts made to date to protect near-natural soil from being built on or damaged through unsuitable land use are insufficient. Greater consideration must be given to the numerous functions and services provided by the resource soil to humans and the environment. Housing construction in built up areas needs to increase in density and oversized development zones must be reduced.

G I.6 Comparison of land requirement, demographic and job development



Sources: FSO; ARE

State: negative

The increase in land use for infrastructure exceeds the increases in the population and jobs. This indicates that the space requirement is excessive and, therefore, that the management of the resource soil may not be sustainable.

Trend: negative

In terms of sustainable spatial development, settlement and urban areas would ideally spread at a rate no faster than the population growth rate. However, this is only the case for industrial zones. The increase in residential land use in recent decades has far exceeded population growth.

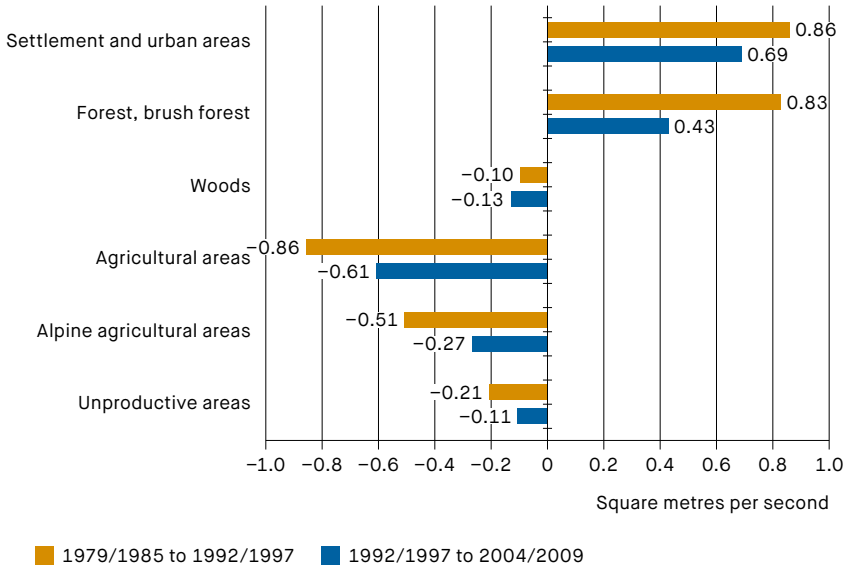
Landscape

With its diversity, beauty and character, Switzerland's landscape is one of the country's most precious assets. Over the past 70 years, the landscape has altered markedly as a result of urbanisation, the expansion of road and rail networks, and the intensification of agriculture. The consequences of this are increased soil sealing, extensive urban sprawl and fragmentation, and the destruction of characteristic features in the landscape. Landscape quality is being lost and with it valuable habitats. This has a negative impact on the well-being of the population, tourism and the attractiveness of locations. Thanks to various political proposals such as the Landscape Initiative, the Second-Home Initiative and the referendum on the revision of the Spatial Planning Act, there is considerable public awareness of landscape as an issue. In September 2012, the Swiss parliament authorised the ratification of the European Landscape Convention.

Action required

Landscape-relevant sectoral policies (in particular spatial development, agricultural, energy and economic policies) must be better coordinated at all state levels. In recent years the federal authorities updated the descriptions of all landscapes and monuments listed in the Federal Inventory of Landscapes and Monuments of National Importance (ILNM), and thus explained their national importance. The new descriptions with their specific protection objectives help the decision-making authorities to weigh up different interests and make their decisions more transparent. The long-term conservation of other valuable landscapes, such as mire landscapes and the UNESCO World Heritage properties, must be guaranteed. The federal authorities also support parks of national importance and the Swiss National Park. Upgrading green open spaces in urban agglomerations also helps to improve the inhabitants' quality of life and to conserve and promote biodiversity.

G I.7 Change in land use



Source: FSO, Land use statistics

State: negative

The current level of land use for built-up areas and infrastructure means that much of the land is sealed over. As a result, the soil is unable to perform its biological functions and there is a loss of agricultural land. In addition, fragmentation and urban sprawl result in a decline in agricultural quality.

Trend: negative

There has been a slight reduction in the negative dynamic changes in land use. The spread of settlement and urban areas remains a key problem, and the need for action is considerable.

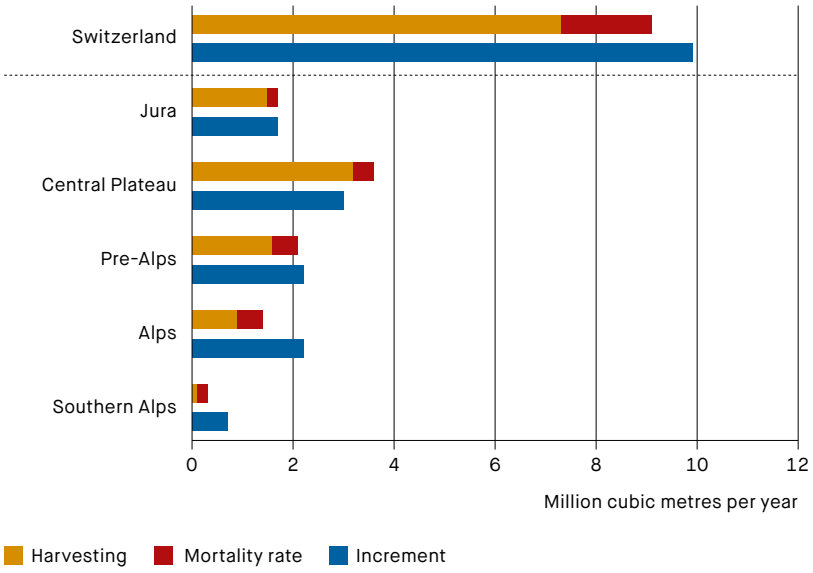
Forest

One third of Swiss territory is covered by forests and they fulfil important functions. Between 1995 and 2013, Switzerland's forests grew in area by 6.7%, mainly in the Alpine region where forest encroached on agricultural land and Alpine pastures that are no longer farmed. In contrast, the forest area in the Central Plateau and Jura remained unchanged. The standing volume of all trees also increased in the same period by 3% to 419 million m^3. Wood harvesting is below the federal authorities' target of 8.2 million m^3 per year. The intensity of harvesting in forest management has a regulating effect on CO_2 – when harvesting levels are low, the forests act as carbon sinks and can contribute to climate protection. Harvested wood can also have a sink effect, for example when it is used as a construction material and thus prevented from decomposing naturally in the long term. The ecological quality and functions of the forest ecosystem (biodiversity, filter effect for the drinking water supply, protection against natural hazards, as a place for recreation and other services) are under threat from the high nitrogen inputs from the air, the migration and introduction of harmful organisms, and climate change. Nitrogen levels in 95% of forest area exceed the critical load limits. Ammonia from agriculture and combustion gases from motorised transport are responsible for this. The federal authorities' response to the various challenges in forest management is contained in the Forest Policy 2020.

Action required

To guarantee forest functions and sustainable forest management in the future, the Federal Act on Forest must be adapted to the altered circumstances. Current developments, such as the threats posed by harmful organisms, climate change, insufficient wood harvesting and the difficulties facing the forestry sector, must be taken into account here. In addition, forest management should continue to accommodate varied forest structures and deadwood, and promote the maintenance of priority habitats.

G I.8 Forest harvesting, mortality rate and increment, 2013



State/Trend: neutral
Increment is broadly in balance with harvesting and mortality rates.

Modelled annual mean values for the years 2009 to 2011.
Source: WSL, NFI 2009/13

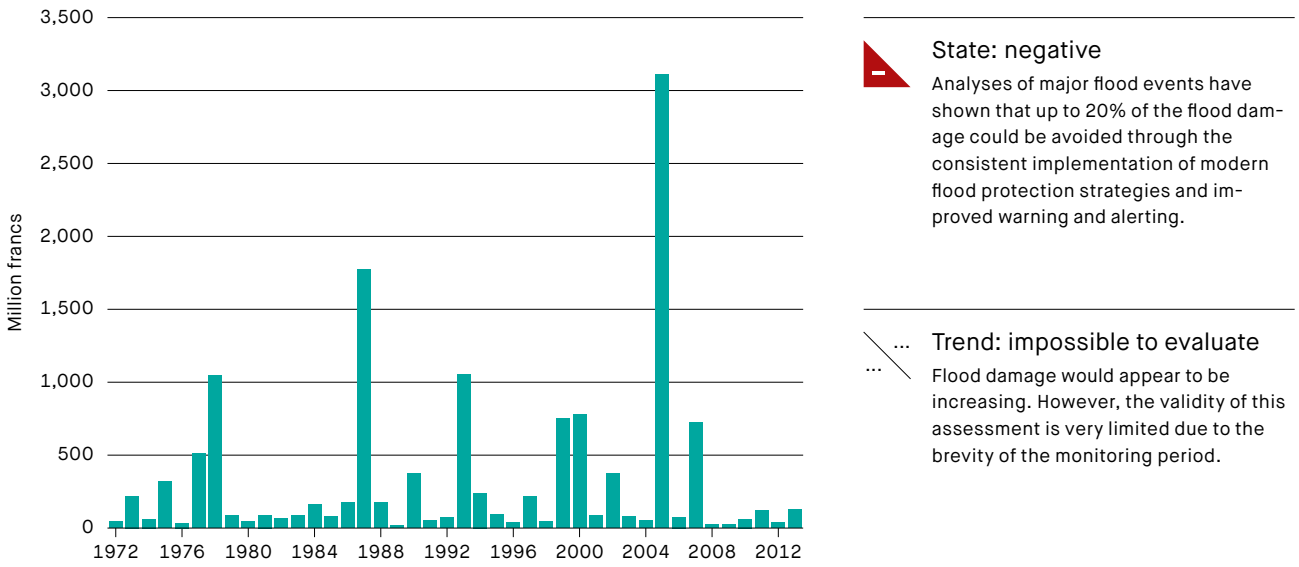
Natural hazards

Between 1972 and 2013, floods, landslides, debris flows, and fall processes generated average annual costs of CHF 325 million. Because land use in Switzerland is increasing in intensity, the risk posed by natural hazards is also growing. The possible impacts of expected climate change could further exacerbate the natural hazard risk. As a result, spatial planning measures are gaining in significance. By the end of 2013, the cantons had largely finalised their compilation of hazard maps and had begun to adapt cantonal structure plans and communal land-use plans to the identified hazards and risks. Of all the natural hazards, earthquakes have the greatest damage potential and can occur anywhere in Switzerland. The federal authorities monitor seismic events, ensure that federally owned buildings are earthquake-proof, and encourage earthquake mitigation measures by the cantons, communes and individuals with a view to making Switzerland's infrastructure systematically earthquake-proof.

Action required

The cantons are responsible for including the findings from hazard mapping in structure and land-use plans. The existing protective infrastructure must be refurbished and expanded. Improvements must be made in relation to the cooperation between all actors in the areas of prevention and response. Measurement and forecasting systems should be further optimised and complemented by prognoses on the expected changes in the climate. Potential victims should be encouraged to take personal responsibility for dealing with natural hazards. All buildings and facilities must be designed and constructed with a view to resisting the impacts of natural hazards. A solution for providing sufficient insurance cover for earthquake damage is also required.

G I.9 Damage[a] caused by floods, landslides, debris flows and fall processes[b]



State: negative

Analyses of major flood events have shown that up to 20% of the flood damage could be avoided through the consistent implementation of modern flood protection strategies and improved warning and alerting.

Trend: impossible to evaluate

Flood damage would appear to be increasing. However, the validity of this assessment is very limited due to the brevity of the monitoring period.

[a] Data adjusted for inflation (base year 2013). [b] Since 2002.
Sources: FOEN; WSL/SLF

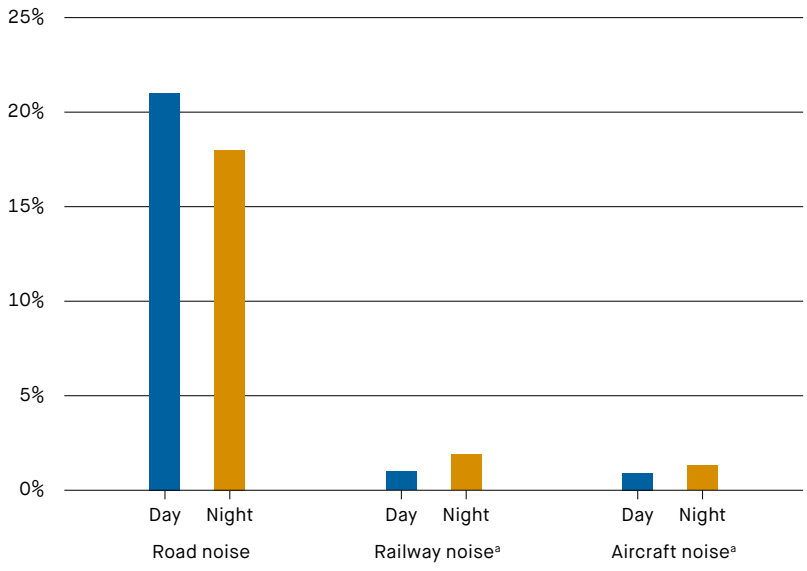
According to model calculations, approximately 1.6 million people, or one in five inhabitants, in Switzerland are exposed to harmful and disturbing road traffic noise during the day; at night, this figure falls to 1.4 million people or one in six inhabitants. Road traffic is by far the most important source of noise. Traffic noise also generates annual external costs of around CHF 1.8 billion. Of this, approximately CHF 1.5 billion is generated by road traffic. Around 60% of these costs are due to the nuisance value of noise (measured on the basis of the decline in property values) and 40% are accounted for by health impacts (in particular, ischemic heart disease and diseases caused by high blood pressure). In addition, noise contributes to social segregation: people who can afford to do so tend to live in quiet neighbourhoods while people with less purchasing power usually have to remain where they are. The noise abatement measures related to roads and railways that have been implemented so far are applied directly at source (night driving ban for trucks, remedial maintenance of railway rolling stock).

Locally implemented measures have focused on noise protection barriers and soundproof windows to restrict the noise or reduce it in the immediate location.

Action required

Traffic noise is set to remain the biggest source of noise. The measures that have been implemented so far will not be sufficient to guarantee the protection of the population required by the Swiss Federal Constitution. Noise must, therefore, be mitigated more effectively by means of direct measures at source, e.g. by building more low-noise road surfaces, reducing vehicle noise emissions, and introducing incentives for low-noise technologies. In addition, areas that are still quiet today and quiet spaces in the proximity of places of work and residential areas must be protected.

G I.10 Persons exposed to traffic noise, 2010



[a] Values from 2006.
Source: FOEN

State: negative
Road traffic noise is mainly reduced by means of noise protection structures (e.g. noise barriers), low-noise road surfaces and speed reduction. Noise abatement targets – to protect the population against harmful or disturbing noise – have not yet been completely met.

Trend: neutral
The expected technical advances in the area of noise protection measures will probably be counteracted by the greater housing construction density, increasing urbanisation, rising demand for mobility and the development towards a 24-hour society.

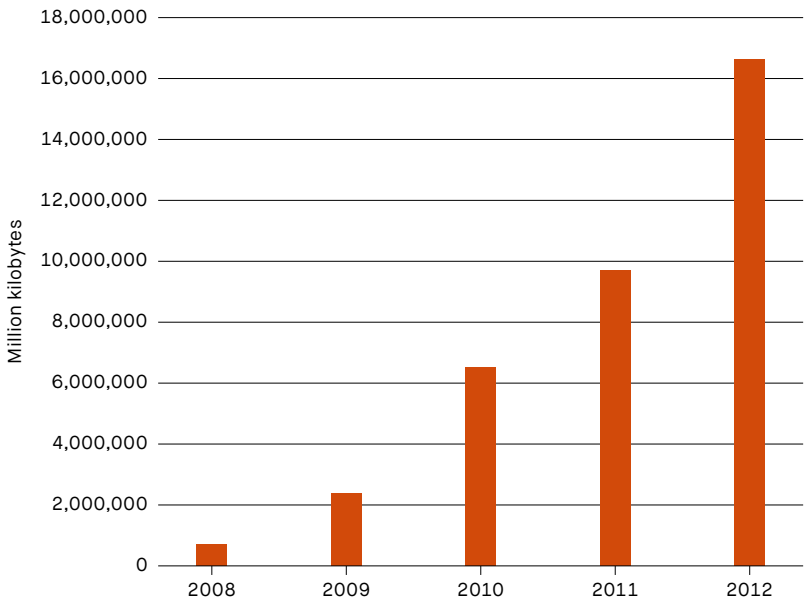
Electrosmog

As smart phones, tablets and other mobile communication devices become more and more popular, the volumes of data they transmit is increasing rapidly and, as a result, people's exposure to electrosmog (non-ionising radiation) is also rising. With the growth in trading on the liberalised electricity markets and an increasing proportion of the energy supply being accounted for by electricity, existing electricity networks are being used more intensively and this can lead to more electrosmog. To reduce scientifically proven health risks from exposure to radiation, the federal authorities have defined ambient limit values. In addition, as a precautionary measure, they have enacted strict limit values for electrical installations to curb any potential long-term health consequences from weak radiation.

Action required

Because experience is still lacking in relation to the long-term impacts of non-ionising radiation, it is essential to continue with the current protection strategy. At the same time, gaps in the knowledge about health risks should be filled, and greater use should be made of the existing scope for the use of low-radiation technologies (e.g. micro cell antennae and buried high voltage power lines in built-up areas).

G I.11 Development of the data volume transmitted by mobile communications in Switzerland



Source: OFCOM

State: neutral

According to the ambient and installation limit values stipulated in the Non-Ionising Radiation Ordinance, exposure to high-frequency radiation is currently relatively low in public areas.

Trend: negative

The volume of data transmitted by mobile communications has increased rapidly. This trend is set to continue in future. Hence the level of exposure to high-frequency radiation in public areas will also increase.

Waste

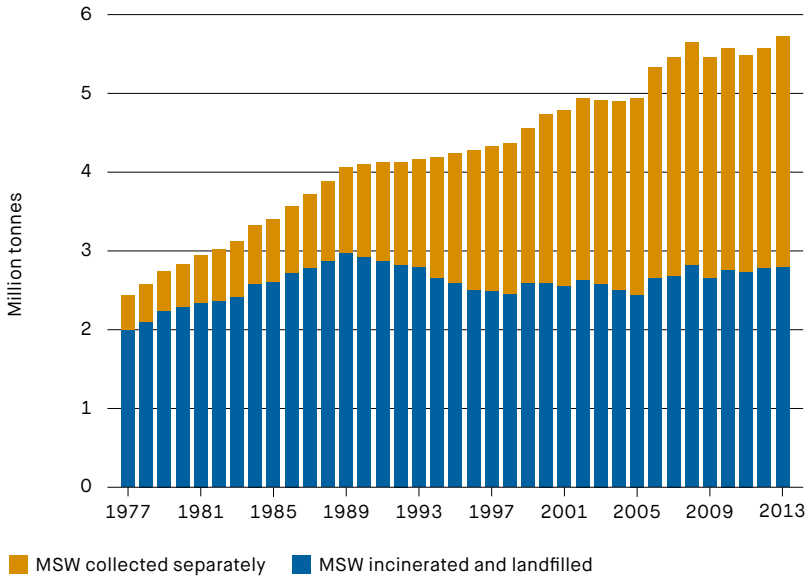
Of the 5.71 million tonnes of municipal solid waste generated in 2013, which corresponds to around 702kg per inhabitant and year, 2.91 million tonnes were recycled and about 2.80 million tonnes incinerated in waste incineration plants. At almost 10 million tonnes, the vast majority of the approximately 12 million tonnes of construction waste generated annually in Switzerland is recycled. The rest is landfilled or incinerated. In 2013, around 2.4 million tonnes of hazardous waste was disposed of, almost 200,000 tonnes more compared with the previous year. This increase can be explained, above all, by waste from the remediation of polluted sites. Approximately 1.3 million tonnes of organic waste is processed in 235 composting and fermentation plants in Switzerland, which have an annual capacity of over 100 tonnes.

Although a well-developed recycling service exists for many types of waste, too many recyclable substances still end up in our waste today. Accordingly, in addition to continuing to treat waste in an environmentally sound way, the main aim of future waste policy will be to optimize the closing of material cycles which currently remain open. Primary resources can be conserved by using recycled materials and substances instead. The federal green economy and waste legislation measures and strategies concern all areas of waste management.

Action required

Waste and raw materials policy should be further developed in the context of the green economy with a view to closing additional suitable material cycles, increasing the use of secondary raw materials, and reducing the raw material requirement and amount of waste produced.

G I.12 Municipal solid waste (MSW)



Source: FOEN

State: negative

The relatively high volume of waste no longer gives rise to a major environmental impact for its disposal. However, it points to the fact that our level of resource consumption remains too high.

Trend: neutral

Because the increase in the volume of waste could be largely counterbalanced by an improvement in the recycling rate, the development is assessed as neutral.

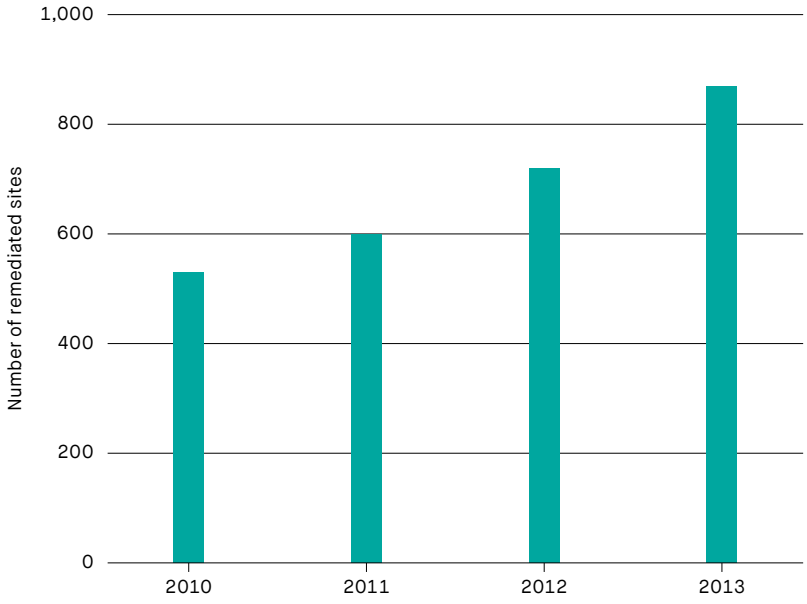
Contaminated sites

According to the registers compiled by the federal and cantonal authorities, there are around 38,000 sites polluted with waste in Switzerland. Most of them are located on the country's industrialised Central Plateau. Around 60% are industrial sites, and the remaining 40% are landfills and a few accident sites. A total of 15,000 sites have been designated as requiring investigation. Of these, over 7,000 had been assessed by the end of 2013. About 4,000 of these sites are believed to pose a threat to human beings or the environment and must be remediated. Approximately 800 have already been remediated. All contaminated sites that pose a serious threat should be remediated by 2017. Remediation work on the other sites must commence by 2025 at the latest. The federal authorities provide around CHF 40 million annually for the remediation of contaminated sites. The required funds come from a levy on the proper disposal of construction waste, filter ash, slag and other waste in landfills. The total cost of the remediation of contaminated sites is estimated at CHF 5 billion.

Action required

The persons responsible for contaminated sites can be required to guarantee that they will pay their share of the costs of investigating, monitoring and remediating such sites. In addition, authorisation is needed if the land on which a site is located is sold or divided into smaller parcels. Related amendments to the Environmental Protection Act came into force on 1 November 2013 and 1 July 2014 and must now be implemented by the cantons.

G I.13 Status of contaminated site remediation



Source: FOEN

State: neutral

A large number of contaminated sites, but far from all, have been remediated.

Trend: positive

Thanks, also, to the support provided by the OCRCS[a] fund, many new remediation projects can be initiated. In addition, numerous, in some cases large-scale, remediation projects are under way which can be completed in the next few years.

[a] Ordinance of 26 September 2008 on the Charge for the Remediation of Contaminated Sites (OCRCS), SR 814.681.

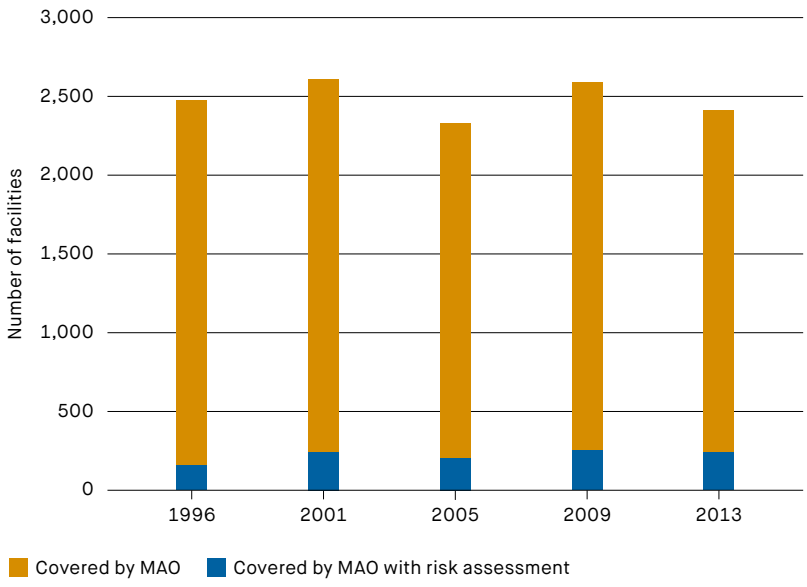
Major accident risks

Around 2,400 facilities in Switzerland deal with hazardous chemicals or with organisms that can harm human health or the environment. All of these facilities are a potential cause of major accidents. Additional risks arise when transporting hazardous goods on roads, rail, on the Rhine, and through the 2,200km of high-pressure gas pipelines and 250km of oil pipelines that run across Switzerland. An event is classified as a major accident when it causes serious harm to humans and/or the environment outside the premises of the facility involved. The owners of facilities, transport routes and pipelines that are subject to the Major Accidents Ordinance are responsible for personally ensuring that all possible state-of-the-art and economically viable safety measures are taken to prevent major accidents. The authorities assess the risks posed by the installations and regularly monitor the implementation of the associated measures. In 2013, 10% of the facilities with hazard potential had to submit or update risk assessments. This has provided the authorities with an overview of the overall risks in the areas concerned.

Action required

Preventing an excessive increase in major accident risks – a major challenge given Switzerland's increasing population density – requires better coordination of spatial planning and major accident prevention. To this end, cantonal land-use plans should take greater account of the Major Accidents Ordinance, which was updated in 2013, and of the guidelines on the prevention of major accidents developed by the federal authorities.

G I.14 Facilities covered by the Major Accidents Ordinance (MAO)



State: neutral

Although facilities with a high damage potential exist, they have taken all technically feasible methods to reduce risks to the population and the environment.

Trend: neutral

In 2013, 241 facilities had carried out a risk assessment. This number had remained largely unchanged since 2001.

Source: FOEN

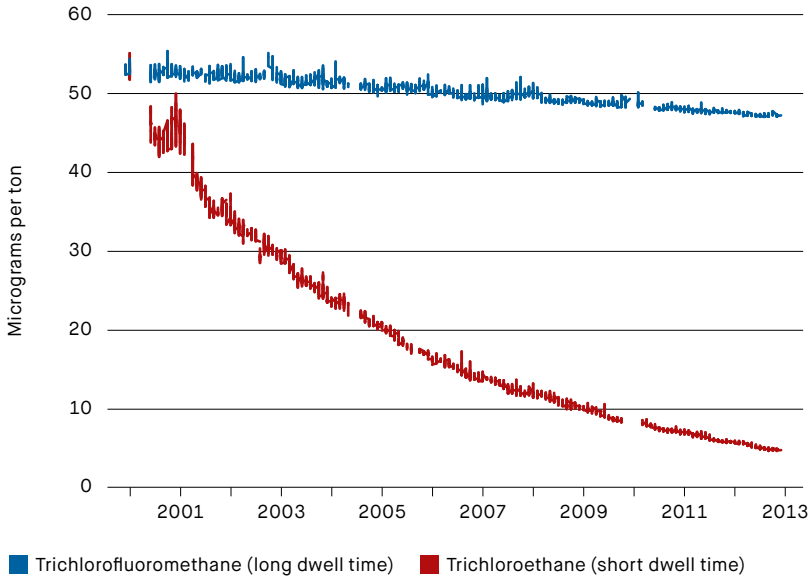
Chemicals

Since 2005, Switzerland has gradually been harmonising its chemicals legislation with the European Union's (EU) regulations so as to achieve similar levels of health and environmental protection. The Federal Council has introduced equivalent provisions for substances of very high concern, some of which are subject to authorisation in the EU, and has adapted the regulations on the authorisation of biocidal products. Switzerland has incorporated the Globally Harmonized System for the Classification and Labelling of Chemicals (GHS), developed by the United Nations, in its Chemicals Ordinance and now uses hazard symbols. In addition, conditions have also been imposed for the responsible use of nanomaterials and related products. The federal authorities have been applying the Action Plan for Synthetic Nanomaterials since 2008, and provide manuals, guidelines and other support. Reducing emissions of ozone-layer depleting and climate-active chemicals is another important issue. It is clear from the graphic below that strictly regulating the use of chemicals with short dwell times in the atmosphere leads to rapid success. In contrast, the impact of reducing emissions of more stable substances is much less marked.

Action required

In 2010, the Federal Council passed a draft negotiating mandate for an agreement on cooperation on chemical safety (a REACH agreement) with the European Union (EU). The negotiations have not yet begun. Until a bilateral agreement has been concluded, Switzerland will continue to implement measures on its own initiative to ensure, as far as possible, that the level of protection provided to health and the environment in Switzerland is not lower than that in the EU.

G I.15 Development in the concentrations of two ozone-depleting chemicals with different dwell times in the atmosphere



State: neutral

Thanks to regulation, pollution with ozone-depleting chemicals is not increasing. However, the current concentrations of these substances in the atmosphere are still somewhat problematic for the ozone layer.

Trend: positive

Thanks to the reduction in emissions and natural decomposition of the ozone-depleting substances, their concentrations in the atmosphere are declining.

Source: EMPA

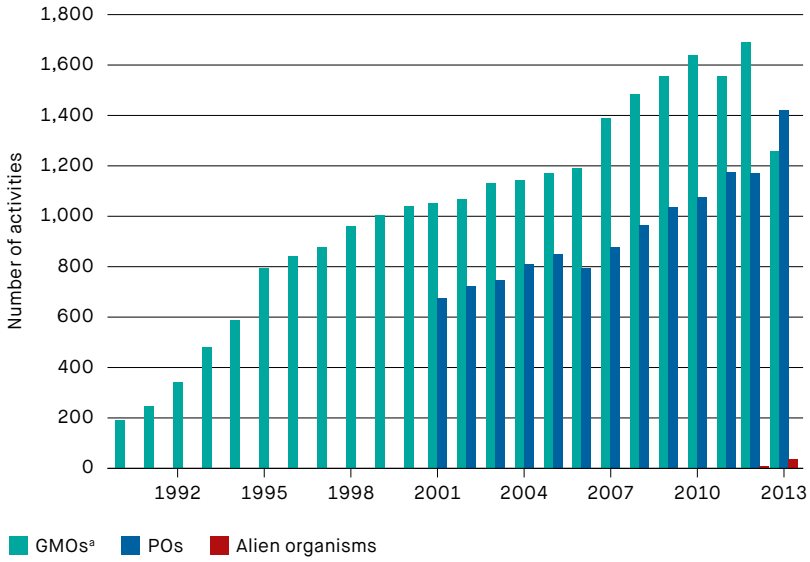
Biotechnology

Biotechnology uses plants, animals and other organisms to develop and test new applications for medicine, industry and agriculture. This work can involve certain risks if the organisms used are genetically modified (GMOs), pathogenic (POs) or alien. To guarantee the protection of human and animal health and of the environment and biodiversity, biotechnology activities are subject to reporting or licensing requirements. A total of 2,717 activities with genetically modified, pathogenic or alien organisms in closed systems like as laboratories had been registered in Switzerland by the end of 2013, and the trend is an upward one. Four release tests with GMOs had been completed by 2014 and one new test had been launched. The risk of the uncontrolled spread of genetically modified plants is increasing with the global rise in their cultivation and trade. In 2012, the federal authorities started a monitoring programme to identify genetically modified plants in the environment. Such plants have been found sporadically at the Rhine port in Basel. The authorisation of activities involving GMOs in the open environment, whether for research purposes or agricultural production, is a controversial issue in Switzerland. In 2012, the Swiss parliament extended to 2017 the moratorium on the cultivation of genetically modified plants in agriculture, which has been in force since 2005. In 2013, Parliament decided to provide financial support for the development of a fenced and monitored test site (protected site) for the purpose of research on GMOs in the open environment.

Action required

The federal authorities plan to intensify the monitoring of genetically modified organisms. For the post-moratorium period, the Federal Council must find a solution for regulating the co-existence of GMO agriculture and GMO-free agriculture.

G I.16 Activities involving the use of genetically modified organisms (GMOs) and pathogenic organisms (PO) in closed systems and of alien organisms



... State/Trend: impossible to evaluate

The rise in activities points to an increase in research; assessment is not practicable.

[a] From 2013, all Class 1 reports (activities involving no or negligible risk) are summarised in new general reports. The number of activities effectively carried out has not decreased as a result, however.
Source: FOEN

International cooperation

The conservation of global life-sustaining natural resources is an important foreign policy objective for Switzerland. Environmental problems do not stop at national borders: Switzerland is dependent on resources supplied from abroad, and strict and consistent international environmental standards prevent trade distortions. Thus, Switzerland protects its own interests through its involvement at international level. Thematic focus areas here include climate, biodiversity, chemicals and waste, water and forests. Within the United Nations Environment Programme (UNEP) and the Organisation for Economic Co-operation and Development (OECD), Switzerland advocates a green economy that takes an efficient and conservational approach to natural resources. It supports a trade system that is consistent with environmental policy concerns. This is important as environmentally relevant decisions are also taken by organisations such as the World Trade Organization (WTO) and the World Bank. Attaining these global environmental goals requires comprehensive and clear regulations, effective institutions and sufficient financial resources (in particular for implementing environmental agreements in developing countries). Together with the other industrialised countries, Switzerland has agreed to provide finance for climate protection, biodiversity, and the responsible management of hazardous chemicals and waste. Another important area of activity is relations with the European Union (EU). Switzerland has been a member of the European Environment Agency (EUA) since 2006. Despite important successes in international environment policy, such as the conclusion of the Convention on Mercury (2013) and further progress on chemicals and waste management and the protection of the ozone layer, the rate at which life-sustaining natural resources are destroyed continues to increase. This poses a long-term threat to both the environment and our well-being and safety.

Action required

Switzerland advocates an effective international climate regime, the further tightening of international environment regulations (in particular in relation to hazardous chemicals and waste and biodiversity), the exploitation of synergies between thematically related environmental agreements, and a more effective UNEP, which assumes the political leadership and plays a coordinating role in all environmental matters within the UN system. At Switzerland's request, UNEP has compiled a summary of all international environmental goals, which should be used to systematically verify the attainment of these goals. It will also help to ensure that the sustainable development goals take sufficient account of environmental matters after 2015. Finally, Switzerland consistently aims to integrate its environmental concerns into its bilateral relations with the EU.

II State of the environment

Human activities can often have adverse effects on the environment. The links between human activities and environmental impacts are discussed in this part of the report using detailed indicator-based analyses. The explanations provided will help the reader to understand the sometimes complex interaction between human activity, the environment and the measures taken. At the end of Part II, the most important environmental impacts in Switzerland and their effects are summarised in two tables.

Part II supplements the information on the individual topics presented in Part I. The analyses and explanations provide an overview of the current state of the environment, its development and trends, and the measures initiated by the federal authorities.

For selected issues, the “View beyond the borders” section compares the situation in Switzerland with that in neighbouring European countries.

The following topics are covered by this section:
Resource consumption and its global consequences – Production – Consumption – Energy – Transport – Built-up areas – Agriculture – Climate – Biodiversity – Air – Water – Soil – Landscape – Forest – Natural hazards – Noise – Electrosmog.

1 Resource consumption and its global consequences

According to the Global Footprint Network, if all the countries in the world consumed resources at same rate as Switzerland, approximately 2.8 Earths would have been needed in 2009 to cover their requirements. More than half of the environmental impact caused by the Swiss population's consumption arises abroad. With the Green Economy Action Plan, Switzerland aims to establish a more resource-efficient economic and consumption model.

Global resource consumption exceeds a naturally sustainable level

Planetary boundaries are being exceeded, particularly in relation to biodiversity loss, the release of nitrogen into soil and water bodies, and greenhouse gas emissions. At the same time, we are gradually reaching limits in other areas, such as the destruction of forests, wetlands and other natural ecosystems, the acidification of the oceans, and freshwater consumption (→ *Rockström et al. 2009*).

If these planetary boundaries are exceeded, tipping points can be set in motion, which can destabilise global environmental systems. It is difficult to predict the consequences of this. For example, if global systems like the Gulf Stream or monsoon fundamentally change in nature, the living conditions of entire continents could be completely altered. Extinct species and exhausted freshwater reserves can never be replaced, over-exploited soils become unproductive wastelands, and climate change causes the sea level to rise, altering the ocean circulation and large-scale weather phenomena in the long term.

In recent decades, economic and population growth have been the most important driver of increased resource consumption and environmental impacts throughout the world. Various studies indicate that Switzerland's resource consumption exceeds the level that can be sustained by nature – particularly when the impact generated abroad is taken into account. This impact is due, for example, to the raw materials and goods which are extracted or manufactured abroad and used in Switzerland. Based on the ecological footprint measured using the Global Footprint Network method, Switzerland's per capita footprint for 2009 was 2.8 times the globally available biocapacity.

F II.1.1 Development of selected aspects of the environment and areas of consumption compared with demographic development in Switzerland, 2010

	Comparison	Comparison
Decoupling	1990 and 2010	2000 and 2010
Energy (final consumption in TJ)	■	■
Electricity (final consumption in TJ)	■	■
CO_2 (in t in accordance with the CO_2 Act)	■	■
Motorised private transport (in vehicle-km)	■	■
Living area[a] (in m^2 per capita)	■	■
Total municipal solid waste (in t)	■	■
MSW landfilled/incinerated (in t)	■	■
Total Material Requirement (TMR, in t)	■	■

■ Absolute decrease ■ Decrease relative to the population ■ Increase relative to the population

[a] Very slight increase from 2000 to 2012.
Sources: FSO; FOEN

The United Nations Environment Programme UNEP has calculated that if the consumption level of industrialised countries remains unchanged and that of developing and newly industrialised countries continues to grow at the current rate, the global depletion of resources will triple by 2050 (→ *UNEP 2011*). The Organisation for Economic Cooperation and Development (OECD) predicts serious consequences for human beings and the environment if there is no fundamental change in the nature of resource use (→ *OECD 2012*).

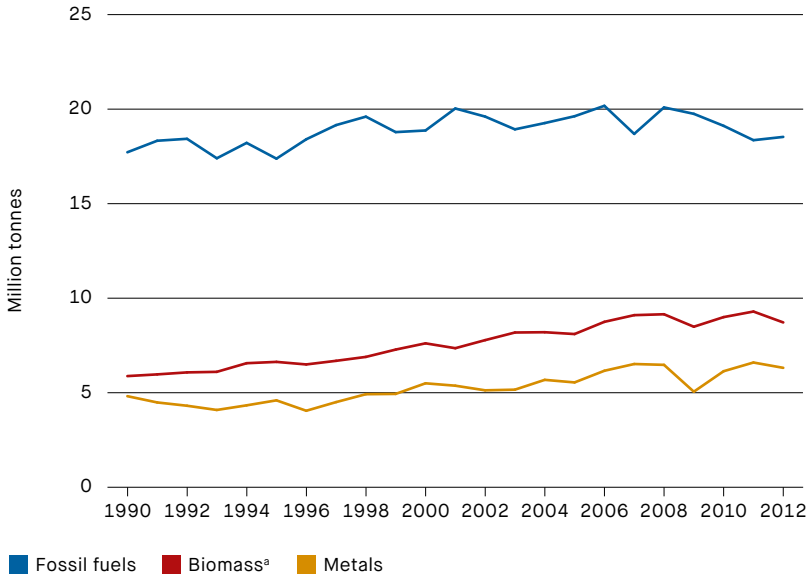
Progress at domestic level

Thanks to environmental policy measures implemented in recent decades, the environmental situation within Switzerland has improved in many respects. However, a uniform picture does not emerge from the detailed examination of individual environmental factors over the last 20 years: for example, the volume of waste, including recyclable waste, generated since 1990 has increased twice as fast as Switzerland's population. Mobility is increasing and residential areas are expanding more rapidly than the population (→ ***F II.1.1***). However, technical progress and the environmental policy measures already in place have undoubtedly made a major contribution to ensuring that resources are used more efficiently today and to the decline in individual types of environmental impacts.

The loss of productive agricultural land is one of the greatest challenges facing Switzerland today (→ ***Chapter II.12***). Pollution of the air and water by contaminants from agriculture and transport also remains at an unacceptable level (→ ***Chapter II.10***, ***II.11***). The character and recreational value of landscapes are threatened by uncoordinated construction activity, and biodiversity is declining because near-natural areas are being lost, their quality as habitats is dwindling, and they are being fragmented by roads and railway lines (→ ***Chapter II.13***, ***II.9***). Due to increasing mobility, a considerable proportion of the population is affected by excessive traffic noise (→ ***Chapter II.5***, ***II.16***). Energy consumption increased almost fivefold between 1950 und 1990, and the number of vehicles on the roads grew by a factor of 20.

Since around 1990, the rate of growth in most of these areas has diminished. Energy and raw materials are generally used more efficiently by the economy today: the material intensity (total material requirement per franc generated) and energy intensity of production (energy consumption per franc generated) declined by 8.2 and 21.6% respectively over this period. When compared with the figures for 1990, a slight reduction in the domestic CO_2 emissions from the burning of fossil fuels and the volume of municipal solid waste that requires incineration was observed in the years up to 2010.

G II.1.1 Imports of selected categories of materials



State: negative
All three categories of goods are associated with extensive environmental impacts abroad.

Trend: negative
Imports in all three categories of goods are increasing.

[a] Food and animal feed, wood, non-synthetic textiles etc.
Source: FSO

The average annual per capita material requirement in Switzerland – from raw material extraction to the end product – is over 11.5 tonnes. Over half of this is building material (gravel and sand) and a further 18.6% comprises biomass (food and animal feed and wood). The rest is divided between fossil fuels and metals (→ ***G II.1.1***; *FSO 2014a*). Among imports, fossil fuels, metals and biomass are associated with particularly serious environmental impacts (→ *FOEN 2013a*). Switzerland is among the 20 countries with the highest per capita material turnover (→ *Wiedmann et al. 2013*).

High impact abroad

The imported metals, fossil fuels and biomass generate a high proportion of their environmental impact abroad. When total consumption in Switzerland is considered, over half of the associated environmental impact arises abroad (→ *FOEN 2011a*).

A similar picture emerges in relation to material requirement: in 2012, approximately 3.3 times more materials were used in other countries to produce and transport goods for Switzerland than accounted for by the imports themselves. The material requirement abroad is increasing faster than the imported volumes over the course of time (→ ***G I.1;*** *FSO 2014a*).

Numerous environmental impacts are accumulating in developing and newly industrialised countries; many of the goods consumed in Switzerland are produced entirely or in part abroad. Examples include the palm oil contained in many foodstuffs and the animal feed imports for Swiss meat and milk production.

Measures: Green Economy

The view that natural resources must be conserved and used more efficiently is gaining ground at national and international level. This affects both the economy and consumption.

Economic prosperity and societal well-being are primarily expressed today in terms of gross domestic product (GDP). However, this is inadequate as a yardstick for well-being. For some years now the debate surrounding alternative systems for measuring these parameters has been intensifying. Various initiatives have been launched which take the additional aspects of quality of life and well-being into account from a more comprehensive perspective (→ *FSO 2012a; OECD 2013; Stiglitz et al. 2009*). The question as to how much material prosperity is needed for people to be satisfied with their lives is also an increasing focus of interest (→ *Kahnemann and Deaton 2010*).

UNEP, the United Nations Environment Programme, presented the Green Economy Initiative in 2008. In 2011, the OECD published its Green Growth Strategy and stepped up its work in this area. The World Bank, the United Nations Industrial Development

Priorities of the Green Economy Action Plan

- → Consumption and production: current consumption patterns and the manufacture of products consume a lot of natural resources and pollute the environment. For this reason, companies should improve the information provided about the ecological aspects of their products and product ranges and promote innovation. In addition, close cooperation with business provides opportunities for further improvements in efficiency.
- → Waste and raw materials: the harnessing and extraction of raw materials has a considerable impact on the environment. Greater importance will be attached to the more efficient use of raw materials and closure of material cycles. The production of goods should involve the use of fewer raw materials and should generate less waste.
- → Overarching instruments: because a large proportion of the overall environmental impact caused by Switzerland is generated abroad, national leverage alone is not sufficient to ensure that the objectives are attained. To establish a green economy the global impact on natural resources through the extraction of raw materials and production of goods must also be reduced through intensified international efforts on the part of Switzerland.
- → Targets, measurement, information, reporting: evaluating whether Switzerland is developing in the direction of a green economy requires the comprehensive measurement of the progress made as a basis for monitoring the success of the adopted measures. This also includes the definition of targets and reporting on progress. The environmental impact abroad should also be taken into account here. Dialogue with business,the scientific community and society is important for the development of the green economy.

Organization (UNIDO), the International Labour Organization (ILO) and other institutions also launched studies in this area. The Global Green Growth Institute (GGGI) is the first global organisation exclusively devoted to the topics of green growth and the green economy. Options for economic practices, ways of life and consumption styles that are less of a burden on the environment are being tested in numerous projects and initiatives, both at home and abroad. The global Green Growth Knowledge Platform (GGKP) in Geneva collates the findings from the various projects and initiatives and makes them readily accessible.

On 8 March 2013, the Federal Council approved the Green Economy Action Plan and it referred the revision of the Environmental Protection Act (EPA)[1] to parliament in February 2014 (→ *FOEN 2013a*). The aim is to conserve natural resources, make consumption more ecological, strengthen the circular economy, and provide information about resource conservation and efficiency (→ ***Infobox "Priorities of the Green Economy Action Plan"***).

The issue of a sustainable and resource-efficient economy is an important one. The way in which resources are used in Switzerland and other countries today leads to the over-exploitation of natural resources, such as soil, water, raw materials etc., while they should be preserved and used more efficiently. This approach is also in the interest of the Swiss economy as it will help it to sustain its competitiveness in the long term.

1 Federal Act of 7 October 1983 on the Protection of the Environment (Umweltschutzgesetz, USG), SR 814.01.

2 Production

Swiss companies have made considerable efforts to make their production activities more environmentally friendly. Despite this, the country's resource consumption still exceeds the level that can be sustained by nature. Many production stages now take place abroad, causing further environmental impacts.

→ The Swiss economy is growing faster than direct energy consumption[1] by businesses. This relative decoupling of economic growth and energy consumption can be explained in part by the exploitation of savings potential and better technologies. A considerable proportion of the energy and natural resources required for the production of the goods and services consumed in Switzerland is expended abroad and imported with the corresponding goods (→ ***Chapter II.1;*** *FOEN 2011a*).

→ Industry and services account for one third of Swiss energy consumption. Industry's energy requirement increased by 2.4% to around 45,700 GWh between 2000 and 2013 (→ *SFOE 2014a*).

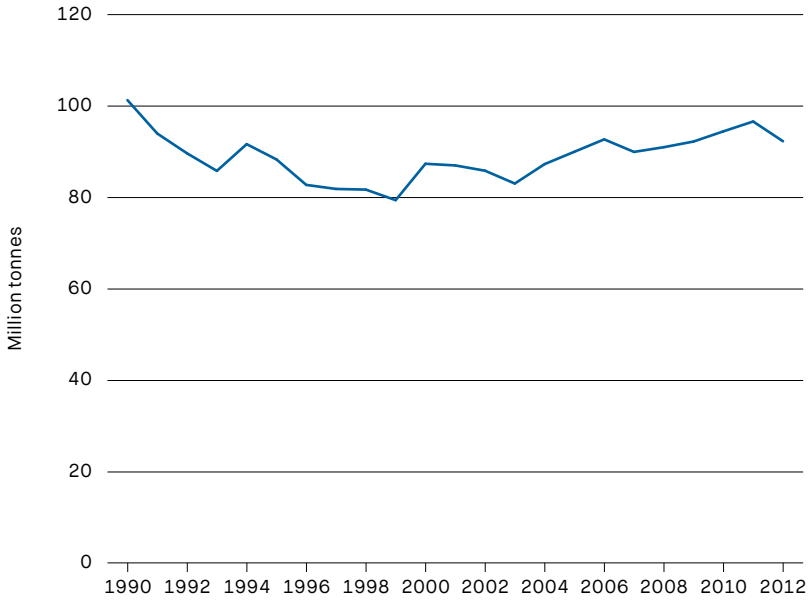
→ When the various forms of environmental impact and the volumes of material used are taken into account, four sectors of the economy have a particularly severe direct impact on the environment: agriculture, the chemical industry, energy and water supply, and the construction sector (→ *FOEN 2013b*).

→ To supply the Swiss population with goods and services, 11.5 tonnes per capita or a total of 92.3 million tonnes of different materials were used in 2012 (→ ***G II.2.1***). Materials required abroad for the production of imported goods are not included in these data. Switzerland's material stock[2] is constantly increasing and grew by around 57 million tonnes in 2012 (→ *FSO 2014a*).

→ Switzerland's domestic material consumption comprises 59.4% minerals (construction materials), 18.6% biomass (including food), 16.3% fossil products (e.g. combustibles and motor fuels), 2.6% metals and 3.2% other products. Sooner or later these materials become waste which is recycled as much as possible for the harnessing of secondary raw materials to be used in the manufacture of new products.

→ In the period between 2001 and 2009, sales of products whose manufacture was environmentally

G II.2.1 Domestic material consumption (DMC)



Source: FSO

State: neutral

Due to the considerable inhomogeneity of the composition (large proportion of gravel/sand but also uranium, etc.), it is difficult to say whether DMC is too high from an environmental perspective. Indeed, Switzerland does well compared to other countries. But this is mainly due to the large services sector and high proportion of imported products, and less to resource efficiency per se.

Trend: negative

DMC has been increasing since 2000. This trend is not good news for the environment. Due to the aforementioned inhomogeneity of composition, however, only limited conclusions can be drawn in relation to negative environmental impacts.

friendly and resource-conserving in sectors like food, construction, energy, mobility, water and waste management grew annually by 6.3% (→ *WWF 2011*). Accordingly, sales in these sectors clearly exceeded the 1.9% overall rate of economic growth as a whole (→ *FSO 2014b*).

→ In 2009, companies active in Switzerland spent a total of CHF 2.75 billion on wastewater treatment, waste management, air pollution control and climate protection, and other environmental protection activities (→ *FSO 2012b*). This environmental expenditure corresponded to around 0.5% of gross domestic product (GDP).

→ The economical use of raw materials conserves natural resources and also pays for itself, as, at around 50% on average, material costs currently represent the highest cost factor for manufacturing companies (→ *Kristof and Hennicke 2010*).

→ Closing material cycles increases material efficiency (→ *FOEN 2013c*). For example, thanks to a new technology, since early 2012 almost one tonne of zinc has been recovered from the filter ash from waste incineration plants every day. Methods of recovering and using phosphorous from waste materials like sewage sludge and animal and bone meal are also being examined. The 13,500 tonnes of phosphorous contained in waste would be almost enough to cover Swiss agriculture's fertiliser requirement, which would considerably reduce dependency on imports.

1 Excluding indirect energy consumption for the production of imported goods (so-called 'grey' energy).

2 Difference between the material inflows and outflows.

3 Consumption

Private household consumption plays a key role in rising global resource consumption and the continuing high levels of environmental pollution. Of all areas involving consumption, nutrition, housing and mobility play a particularly prominent role in Switzerland,

→ Private household consumption was the most important driver of growth in the Swiss economy in 2012. It was the main contributor to the 1.3% increase in the gross domestic product (GDP) (→ *FSO 2014c*).

→ Between 1990 and 2012, consumption expenditure increased by 74% to CHF 328 billion. The population only increased by 19% over the same period. Almost one quarter of consumption expenditure in Switzerland is accounted for by housing and heating costs; 12.5% is for food, drinks and tobacco and 11.6% for transport and communications (→ ***G II.3.1;*** *FSO 2014d*).

→ Simultaneous to the increase in consumption, the volume of waste produced has also grown in recent decades. Each person in Switzerland generates around 2kg of municipal solid waste per day. This corresponds to an annual volume of around 5.5 million tonnes of waste for all of Switzerland (→ ***G I.12;*** *FOEN 2014a*).

→ Two thirds of the total annual per capita environmental impact is generated by the consumption sectors of nutrition, housing and private mobility (→ *FOEN 2011a*).

→ At 28%, nutrition contributes most to the environmental impact generated by consumers. Meat and other animal products are the main factors here. They cause almost half of this impact as their production requires a lot of energy for cultivating the soil, and they also require the use of plant protection products, fertilisers and intensively farmed agricultural land (→ *FOEN 2013b*).

→ Some 290kg of food per person is thrown away annually. Consumers are responsible for one third of these food losses. A four-person household spends around CHF 2,000 per year on food that ends up in the bin (→ *FOAG 2012*).

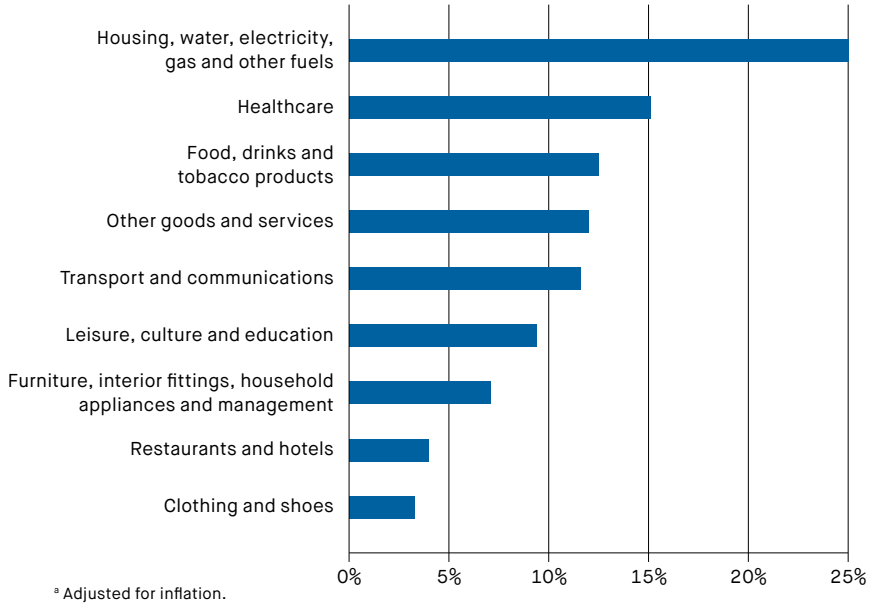
→ The number of persons per household has decreased and the average living area per person has increased steadily in recent decades (→ *FSO 2013a*). Housing

(including heating, electricity, hot water, wastewater treatment and waste disposal), which represents 19% of the total environmental impact generated by Switzerland, is the second most important area of consumption. The most important components here are heating oil and electricity consumption, followed by waste and wastewater disposal and natural gas consumption.

→ At 12% of the total environmental impact, private mobility comes in third place. Journeys made by car play by far the most important role here, and are followed by aeroplane journeys and the use of motorcycles. Air pollutants and greenhouse gas emissions are the most harmful environmental consequences of mobility (→ ***Chapter II.5***).

→ Consumption in Switzerland generates considerably more than half of its environmental impact abroad (→ ***Chapter II.1***). The reasons for this are, first, many raw materials must be imported because they do not occur naturally in Switzerland, and, second, many of the goods consumed here are foreign in origin or in composition. For example, imported livestock feed requires a cultivation area of around 2,700km^2 abroad, an area that corresponds to the territory of the cantons of St Gallen, Appenzell and Schaffhausen (→ *Vision Landwirtschaft 2010*).

G II.3.1 Composition of consumer expenditure,[a] 2012



[a] Adjusted for inflation.
Source: FSO

State/Trend:
Impossible to evaluate

Because the distribution of consumer expenditure is not good or bad a priori, the diagram is not evaluated.

4 Energy

Switzerland's energy consumption has stabilised at a high level. The planned gradual withdrawal from nuclear power should succeed, however, without causing any further increase in the dependency on fossil fuels. For this reason, the Energy Strategy 2050 aims to increase energy efficiency and promote the sustainable use of renewable energy sources. This usually gives rise to a reduction in the associated environmental pollution. However, conflicts could also arise with the objectives of nature conservation.

→ After several decades of strong growth, Switzerland's energy consumption stabilised from the year 2000 while gross domestic product (GDP) and the population continued to grow. Energy use has, therefore, became more efficient. Electricity consumption has also stopped tracking the growth rates of GDP and the population since 2005 (→ ***G II.4.1***).

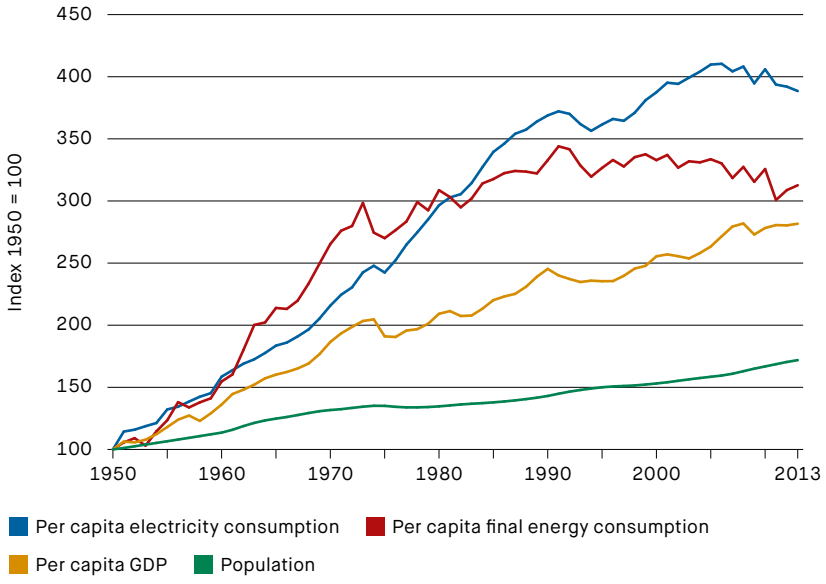
→ At 35%, transport consumed most energy in 2013, followed by households at 29%. Approximately two thirds of the energy requirement was covered by fossil combustibles and motor fuels (petrol, diesel, heating oil, natural gas etc.) (→ *SFOE 2014b*). These are responsible for around three quarters of Switzerland's greenhouse gas emissions. They are also the main source of the air pollutants particulate matter and nitrogen oxides.

→ In 2013, 22% of domestic energy consumption originated from renewable energy sources, mainly hydropower. Wood, solar, biogas, ambient heat and biofuels accounted for less than one tenth of energy consumption (→ *SFOE 2014c*).

→ This purely national perspective does not consider the fact that many of the goods consumed in Switzerland are produced abroad in processes with a high energy requirement. This is not reflected in Switzerland's statistics. According to model calculations, the primary energy requirement needed to cover Swiss final consumption is around 8,000 watts per person. Of this energy, over 95% is consumed abroad, and most of it originates from non-renewable sources (→ *FOEN 2014b*).

→ As part of its first package of measures for the Energy Strategy 2050, the Federal Council proposes to give highest priority to promoting efficient energy use (→ *Federal Council 2013a*). By 2035, the average

G II.4.1 Development of electricity and final energy consumption and per capita Gross Domestic Product (GDP), 1950–2013



Sources: SFOE; FSO

State: negative

Due to the high proportion of fossil fuels involved, today's high energy consumption is a decisive factor in climate change and air pollution.

Trend: neutral

Although energy consumption has increased markedly in recent decades, an improvement may be expected with the implementation of the Energy Strategy 2050.

energy consumption per person and year should be reduced by 43% compared with the year 2000. The corresponding target value for electricity consumption is minus 13%. With the reduction in consumption, the environmental impact associated with the provision of energy also decreases.

→ The Energy Strategy 2050 also intends that, in future, renewable energies will make a far greater contribution to the electricity supply and should replace part of the electricity lost through the withdrawal from nuclear power. The production of electricity from new renewable sources should increase by a factor of seven by 2035 as compared with 2012. In the case of electricity generation from hydropower, an increase in production of 5 to 6% is planned for the same period.

→ The replacement of fossil fuels with renewable energy usually results in a lower environmental impact. However, the opposite can be the case if the uniqueness and value of intact habitats and landscapes are seriously impaired by new hydropower or wind energy installations. Due to the ambitious objectives of the Energy Strategy 2050, such conflicts cannot always be avoided. The conflicting interests of nature conservation and energy use should, therefore, be carefully balanced – taking the relevant standards and regulations into account.

5 Transport

The volume of passenger and freight traffic is continuing to grow. Traffic is the main cause of noise and the principal source of nitrogen oxide and greenhouse gas emissions in Switzerland. Transport routes seal the soil, fragment the landscape, and damage animal and plant habitats.

→ In 2010, every Swiss inhabitant travelled an average daily distance of 36.7km within the country. Of these journeys, 40% were accounted for by leisure travel and 24% by work-related travel. While commuting distances have increased considerably over the past 15 years, the distances travelled for leisure purposes have tended to decline (→ *FSO/ARE 2012*).

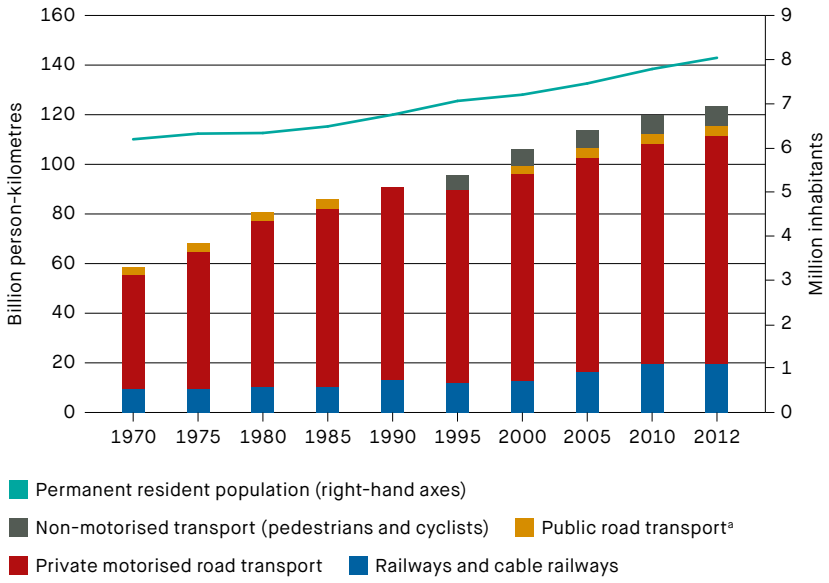
→ Between 2000 and 2012, the mileage[1] covered by passenger and freight vehicles on Swiss roads increased by around 15% and 18% respectively. This increase reflects the growth in the number of passenger and freight transport vehicles, which was 21% more in 2012 than in 2000 (→ *FSO 2013b*).

→ The increase in mileage counteracts the efforts being made to reduce the transport-related environmental impact. Despite technical progress, traffic is an important source of particulate matter and nitrogen oxides. In addition, according to model calculations, every fifth person in Switzerland is exposed to harmful or disturbing road traffic noise during the day.

→ The average motor fuel consumption per 100km has declined considerably since 2000. Despite this, due to the increased mileage, road traffic consumed a total of 3.6% more motor fuel over the same period (→ *SFOE 2013*). In 2012, around one third of total energy consumption and 32% of Switzerland's greenhouse gas emissions were transport-related (→ *FOEN 2014c*).

→ Mileage in the area of rail passenger transport[2] has increased by over 50% since 2000 (→ ***G II.5.1***). The trend in the area of rail freight transport is different. Thanks to the introduction of the mileage-related heavy goods vehicle charge (HGVC) and the policy of shifting Alpine freight traffic from road to rail, the mileage here increased by 10% in the period 2000 to 2008. Between 2000 and 2012, the proportion of rail freight transport in relation to total traffic in Switzerland declined from 42% to 36% (→ *FSO 2013c*).

G II.5.1 Development of passenger transport and demographic growth



[a] Time series interrupted from 1986 to 1997 due to new calculation method.
Source: FSO

State: negative
The negative environmental impacts arising from current transport levels are considerable: noise pollution, air pollution, CO_2 emissions, landscape fragmentation etc.

Trend: negative
Passenger transport increased markedly in recent decades. This can mainly be explained by the rise in private motorised transport. This trend is not expected to change.

→ According to the latest land-use statistics for 2004/2009, transport infrastructure in Switzerland covers an area of around 952km². Within a quarter of a century – between the 1979/1985 and 2004/2009 land-use survey periods – the surface area covered by transport routes increased by 16% (→ *FSO 2013d*). Soil sealing and the fragmentation of natural habitats are closely related to the development of transport area.

1 Mileage refers to the distance travelled by vehicles on Swiss territory over the course of one year (measured in vehicle-, train- or route-kilometres).

2 Mileage refers to the distances travelled by persons or goods tonnes (measured in person- or tonne-kilometres).

6 Built-up areas

The expansion of Switzerland's settlement and urban areas continues unabated and at a rate faster than population growth. Natural resources are used intensively in the built-up areas. Urban sprawl has increased considerably over the last three decades.

→ Year on year, settlement and urban area (buildings and transport infrastructure) takes up more and more space in Switzerland. In the twelve years between the land use statistics of 1992/1997 and 2004/2009, settlement and urban area grew by a good 9% (→ *FSO 2013d*). Compared with the preceding twelve-year period, the growth rate has slightly decelerated. At almost 8%, the population also grew slightly more slowly in the period 1992/1997 to 2004/2009 than in the preceding twelve-year period (→ *FSO 2014e*). At the same time, with a growth rate of a good 5%, more jobs were created (→ *FSO 2014f*).

→ According to the latest land use statistics, settlement and urban area has reached 407m² per capita (→ *FSO 2013d*) and corresponds, therefore, to the upper limit defined by the Federal Council in the national sustainable development strategy (→ *Federal Council 2012a*). In the urban agglomerations, the average of settlement and urban areas

has remained stable at 305m² per capita, but has increased to 672m² in rural areas (→ *ARE 2014a*). A relative decoupling of population and the spread of built-up areas can be observed, therefore, in urban agglomerations.

→ With the adoption of the Spatial Planning Act on 3 March 2013, measures were introduced to stem the consumption of land: oversized development zones must be reduced and better use must be made of existing reserves of development land.

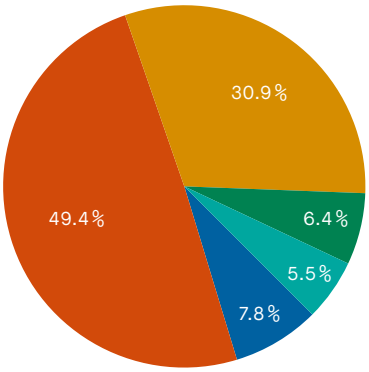
→ Urban sprawl has increased markedly over the last 30 years. Landscapes are more prone to urban sprawl the more developed area they have, the more dispersed the settlement and urban areas are, and the lower the level of land-use for residential and work purposes is (→ *Schwick et al. 2010*). Whereas the urban sprawl in some cities, for example Basel, Geneva and Zurich, declined between 2002 and 2010, it increased considerably in 93% of all Swiss communes (→ *Schwick et al. 2013*).

→ Settlement and urban area is 60% sealed (i.e. covered by buildings, traffic areas and other impervious infrastructure) (→ ***G II.6.1;*** *FSO 2013d*). Nevertheless, it provides highly diverse small habitats for adaptable plants and animals (wasteland, old trees etc.).

→ The plant protection products and biocides used in the maintenance of gardens and green areas in built-up areas enter water bodies and the soil. Moreover, at over 80%, the proportion of watercourses in built-up areas that are engineered and culverted is almost four times higher than the average for all of Switzerland (→ *FOEN 2009a*). Watercourses can be rehabilitated to restore some natural functions and this can also improve the quality of life and attractiveness of neighbourhoods.

→ A large proportion of the population spends its time in built-up areas, and this is also where material assets (buildings, facilities, other property etc.) are concentrated. The risk of damage to persons and property is correspondingly high in such locations. The floods of 2005 alone gave rise to damage totalling CHF 3 billion (→ ***G I.9***). These risks can be reduced considerably by adapting spatial plans and urban development (→ ***Chapter II.12***).

G II.6.1 Settlement and urban areas based on land-use categories, 2004/2009



Transportation areas
Recreational areas and cemeteries
Special urban areas
Industrial and commercial areas
Building areas

Source: FSO, Land use statistics

State/Trend:
impossible to evaluate

Because the composition of land-use categories is not good or bad a priori, the diagram is not evaluated.

7 Agriculture

As the biggest user of land in Switzerland, agriculture bears a lot of responsibility for biodiversity, climate, water and soil protection, and air pollution control. The improper use of fertilisers and plant protection products and unsuitable management methods can have an extensive environmental impact. With the Agricultural Policy 2014–2017, the federal authorities aim to achieve a more efficient use of resources and the use of production methods that are better adapted to local conditions.

→ In 2011, 48% and 77% respectively of plant and animal foodstuffs supplied to the domestic population originated from domestic production (excluding animal-based food products which were manufactured on the basis of imported feed) (→ *FOAG 2014*).

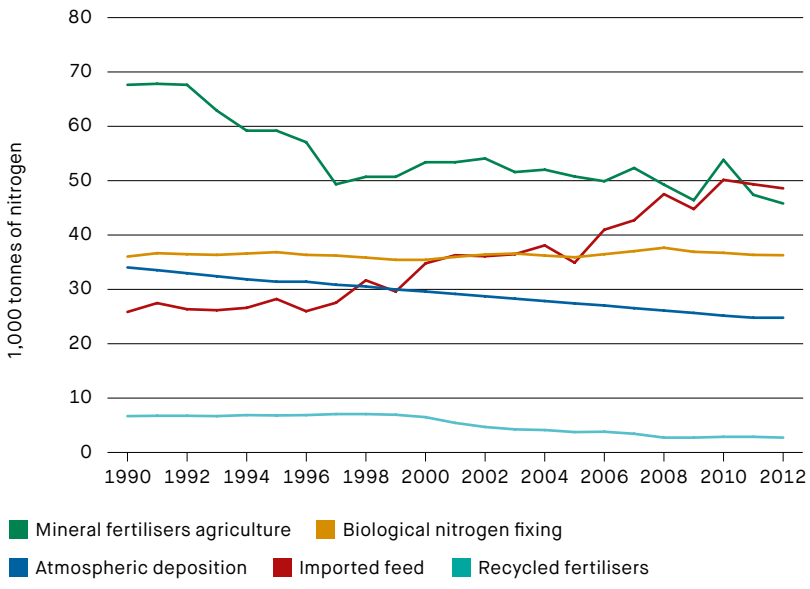
→ Farms use over one third of the national territory and, accordingly, shape the Swiss landscape. In the twelve years between the land use statistics of 1992/1997 and 2004/2009, agricultural areas declined by 2.2%. Approximately two thirds of these losses are due to the spread of built-up areas, and one third is due to reforestation on areas in the hill and mountain regions that are no longer used for agricultural purposes (→ *FSO 2013d*).

→ Every year, plant protection products containing around 2,200 tonnes of active ingredients are sold in Switzerland (→ *FOAG 2014*). The pollution they cause depends not only on the volume used, but also on the toxicity of the substances, their behaviour in the environment, the ways and places in which they are used, and weather conditions.

→ In the period 2010–2012, Swiss agriculture polluted the air with an annual average of around 48,000 tonnes of nitrogen in the form of ammonia (→ *FOEN 2014d*). The maximum environmentally safe volume is 25,000 tonnes (→ *FOEN 2008*). Ammonia is a major precursor in the formation of particulate matter and a key contributor to the over-fertilisation and acidification of natural ecosystems.

→ Nitrogen is indispensable, however, as a fertiliser for agricultural crops. Mineral fertilisers and animal feed imports, which enable large livestock holdings, increase the volume of nitrogen in the agricultural system (→ ***G II.7.1***). The risk of nitrogen inputs into the air and water also increases in this way.

G II.7.1 Nitrogen inputs in agriculture



Source: ART

State: negative

Atmospheric nitrogen deposition in particular remains too high for natural ecosystems and results in over-fertilisation.

Trend: neutral

The reduction in nitrogen deposition is balanced out by the increasing volume of imported feedstuffs.

→ A good 13% of agricultural land is farmed and managed in Switzerland as extensive and low-intensity meadows and pastures, bedding meadows, fallow strips sown with wild flowers, hedges, and other biodiversity priority areas. While the proportion of land managed in this way is around 10% in the valley and hill regions, it exceeds 22% in mountain regions. Approximately one third of biodiversity priority areas meet increased quality requirements and interconnection projects have been carried out on around two thirds of these areas (→ *FOAG 2014*).

→ Through the Agricultural Policy for 2014–2017, which was passed by parliament in 2013, the federal authorities promote the more efficient use of resources and production methods that have been adapted to local conditions (→ *Federal Council 2012b*). They support services that promote the landscape and biodiversity by providing subsidies for cultivated landscapes, landscape quality and biodiversity. Subsidies for these services accounted for 30% of all direct payments in 2014. This percentage is set to rise to 36% by 2017.

→ Subsidies for resource and water protection projects and resource efficiency subsidies support the more sustainable use of fertilisers, plant protection products, soil and water bodies. For example, subsidies are provided for the use of trailing hoses, thanks to which less ammonia escapes during the spreading of manure.

8 Climate

The CO_2 Act provides the basis for reducing greenhouse gas emissions and adapting to climate change in Switzerland. By purchasing emission reduction certificates, Switzerland has reached its Kyoto emission reduction target. At international level, Switzerland plans to commit to further emission reductions by 2020.

Context

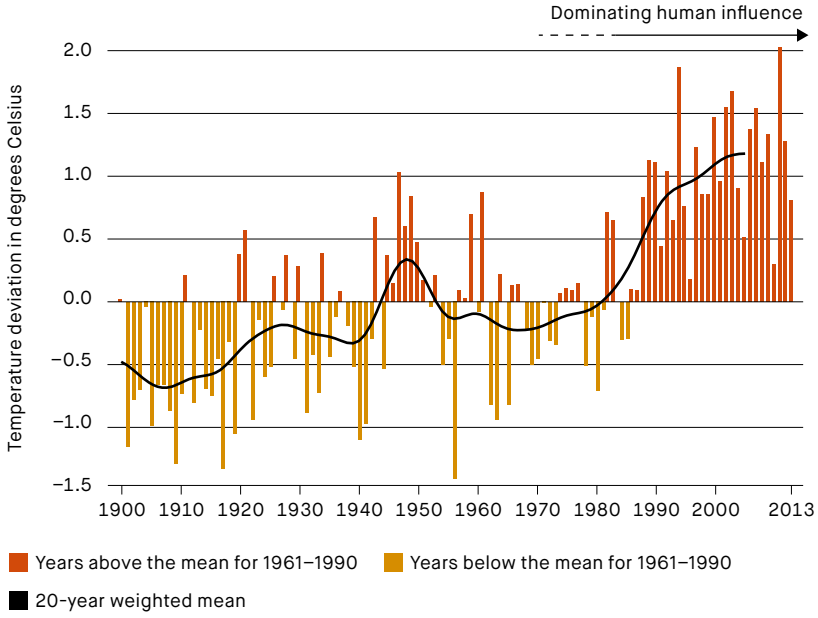
The Kyoto Protocol, which was adopted in 1997,[1] requires industrialised countries to reduce their greenhouse gas emissions. For the period 2008 to 2012, Switzerland committed to a reduction target of 8% compared to emissions in 1990. Thanks to measures implemented at domestic level, it succeeded in meeting this commitment by purchasing certificates for greenhouse gas reductions abroad and by offsetting emissions against the effect of its forests as a CO_2 sink.

A second commitment period under the Kyoto Protocol was agreed in late 2012. Along with other industrialised countries, Switzerland committed to reducing its emissions by 20% compared with 1990 by 2020, subject to the approval of parliament. This corresponds to the requirements of the revised CO_2 Act[2] (in force since 1 January 2013). Switzerland's commitment was made in the context of the voluntary reduction targets to be achieved by newly industrialised countries and numerous developing countries by 2020, and in line with a new agreement for the post-2020 period, which should involve commitments by all states, i.e. both industrialised and developing countries.

Switzerland also succeeded in fulfilling the general objective of the 'old' CO_2 Act. A combination of climate policy measures at domestic level and the purchase of emission reduction certificates abroad resulted in total CO_2 emissions from fossil fuels for the period 2008–2012 falling to an average of 10% less than in 1990. However, the specific objectives for combustibles and motor fuels were not achieved. Under the Kyoto Protocol, the target of a 20% reduction by 2020 set in the revised CO_2 Act relates to all greenhouse gases and should be achieved through measures at domestic level.

Since 1990, domestic greenhouse gas emissions have remained stable at 50 to 54 million tonnes of CO_2 equivalents (CO_2eq)[3] per year – despite eco-

G II.8.1 Annual mean temperature in Switzerland[a]

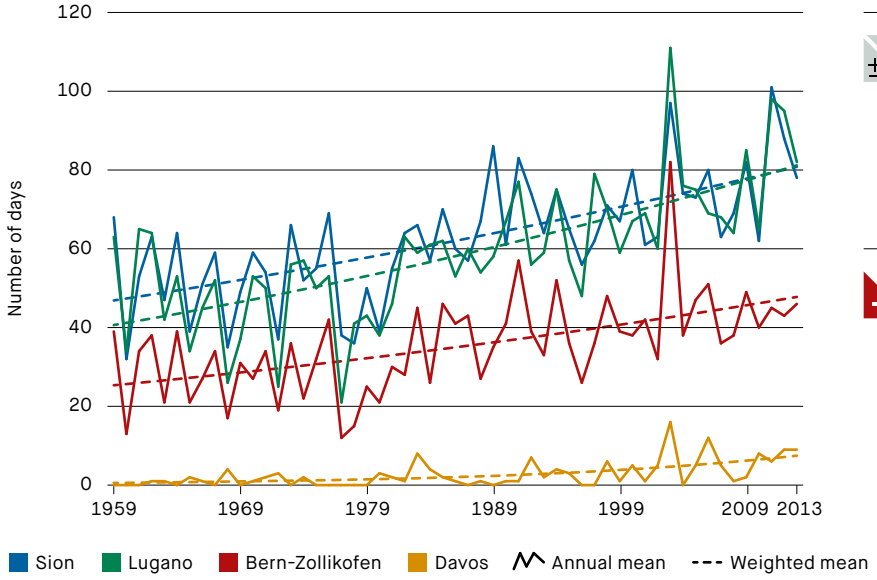


State: neutral
The annual mean temperature cannot be assessed as either positive or negative.

Trend: negative
Annual mean temperatures since the 1980s have been systematically higher than the mean for the years 1961–1990. The changes in general climate conditions are unfolding relatively quickly, with the result that ecosystems and endangered economic sectors (e.g. winter tourism) cannot adapt to the new conditions.

[a] Deviation from mean for 1961–1990.
Source: METEOSWISS

G II.8.2 Number of summer days[a] since 1959



State: neutral

In principle, the number of summer days may not be evaluated as either positive or negative.

Trend: negative

The number of summer days has tended to increase in recent decades. This trend is accompanied by an increase in the average temperature and in the associated negative impacts on humans and the environment.

[a] Maximum temperature above 25 degrees Celsius.
Source: METEOSWISS

nomic and population growth (→ *FOEN 2013d*). This means that per capita emissions have declined considerably. Whereas 7.8 tonnes of CO_2eq were recorded per person in 1990, this value had decreased to 6.4 tonnes by 2012.

However, Switzerland is importing an increasing volume of products, the manufacture of which generates greenhouse gas emissions abroad (→ ***Chapter II.1***). If these emissions are added to the domestic figures, the total per capita emissions for 2011 are 13.7 tonnes of CO_2eq, which is almost twice the volume of emissions generated directly in Switzerland (→ *FOEN 2014b*).

At 32%, the transport sector is the most important emitter of greenhouse gases at domestic level, followed by industry at 21% and households at 20%. A further 12% of emissions are generated by agriculture (→ ***G I.2***). The greatest potential for the reduction of overall emissions lies in the transport and buildings sectors.

The dominant greenhouse gas is CO_2. It accounts for around 85% of total emissions, and this has hardly changed since 1990. Methane and nitrous oxide emissions, which mainly originate from agriculture, are declining. Emissions of synthetic greenhouse gases (HFCs, PFCs, SF_6) have increased, a development related to the measures implemented to protect the ozone layer (replacement of banned chlorofluorocarbons CFCs, HCFCs).

Impacts

Since the early 20th century, the average temperature in Switzerland has increased by around 1.75°C (→ ***G II.8.1***). Since the beginning of temperature measurements in Switzerland in 1864, 17 of the warmest 20 years were recorded after 1990.

Climate change can be clearly observed in the increase in the number of summer days with maximum temperatures exceeding 25°C (→ ***G II.8.2***), in the reduction in the number of frost days with minimum temperatures of below 0°C and in the rise in the zero degree line. Today, the latter is around 350 metres higher on average than in the late 1950s. As a result, the number of days with snow cover is declining generally and the vegetation period is getting longer (→ *FOEN 2013e*).

Glacier melt in the Alps is a direct consequence of the rising average temperatures. This process releases a lot of unconsolidated rock, renders mountain flanks unstable and results in the formation of new lakes in the glacier foreland where the glacier has disappeared. These changes bring both risks (e.g. more serious natural hazards) and opportunities (e.g. for hydropower generation).

For example, in 2008 the highway across Grimsel near Guttannen (Bern) had to be relocated onto a protective embankment after it had been repeatedly blocked by landslides. On a more positive note, the lake that formed below the Trift Glacier (Bern) around the year 2000 is now a tourist attraction. It could be used as a reservoir for hydropower production in the years to come.

Climate change also affects wildlife. The habitat of the Brown Trout, which needs cool temperatures to survive, has declined over the past 30 years. A similar development is expected for numerous breeding birds in the Alpine region, such as the Ring Ouzel, which has been included in the Red List of Endangered Species. Conversely, individual thermophilic bird species are expanding, for example, the Yellow-legged Gull and the European Bee-eater (→ *FOEN 2013e*).

It is not possible to observe any significant trend from the measurement data for precipitation in recent decades. Based on model calculations, it is expected that in summer longer periods of drought will become more frequent, and the flow regime of rivers will change considerably (→ ***Part III***).

Measures

The main basis for Swiss climate policy is the revised CO_2 Act, which came into force on 1 January 2013. The primary aim of this act is to reduce domestic greenhouse gas emissions by at least 20% by 2020 compared with 1990. A new aspect of the revised Act is that it concerns not only CO_2, but all other greenhouse gases regulated at international level. In addition, the role of the federal authorities in measures for adapting to the impact of climate change is also regulated in the Act.

Furthermore, putting synthetic greenhouse gases (HFCs, PFCs, SF_6) into circulation and using them in refrigerators, air conditioning systems, foams and spray cans, and in fire retardants and solvents is severely restricted under the Chemical Risk Reduction Ordinance.[4]

The CO_2 levy is the main instrument for attaining the climate protection objectives. It has been applied to fossil combustibles like heating oil and natural gas since 2008. The levy acts as an incentive to reduce CO_2 emissions.

The Ordinance on the CO_2 Levy[5] specifies target values for CO_2 emissions from the use of fossil combustibles for the years 2012, 2014 and 2016. The target value for 2012 was clearly exceeded; as a result, and as stipulated in the Act, the levy was increased on 1 January 2014 from CHF 36 to CHF 60 per tonne of CO_2 emitted. A further increase in the levy is planned from 1 January 2016 if it emerges in summer 2015 that the target for 2014 has not been attained.

Companies that emit large volumes of CO_2 can avoid the levy if they commit to limiting their emissions or participate in emissions trading. Over 50 companies, which together emit around 5 million tonnes of CO_2, participate in Switzerland's emissions trading scheme (ETS). The EU also has an Emissions Trading System. Efforts are underway to link the two systems to allow the mutual recognition of emissions rights. The establishment of a uniform price for emission allowances would eliminate market distortion between Swiss and European companies and offer greater flexibility to Swiss companies, in particular with regard to their emission reductions. Moreover, linking the two systems could lay the foundations for a global emissions trading system.

One third of the revenue from the CO_2 levy (a maximum of CHF 200 million to 2012 and a maximum of CHF 300 million from 2012) is allocated to the federal and cantonal Buildings Programme. Since 2010, this programme has been promoting energy-saving measures in buildings, investments in renewable energy sources, waste heat recovery and the optimisation of building services technology. Under the current legislation, the programme will run until the end of 2019.

In 2013, subsidies of around CHF 131 were channelled through the Buildings Programme for measures involving the insulation of existing buildings. Some 11,000 projects benefited from these subsidies. As part of the cantonal element of the Buildings Programme, CHF 80 million was paid out for renewable energies, waste heat recovery and building services technology. Thanks to the increase in the CO_2 levy from the beginning of 2014, additional funding is now available for the Buildings Programme.

By late 2013, a reduction of around 22 million tonnes of CO_2 – as calculated for the entire lifespan of the measures – had been achieved through the meas-

ures from federal and cantonal programmes implemented since 2000.

Fossil motor fuels (petrol, diesel, natural-gas-based fuels, aviation fuels) are not affected by the CO_2 levy. Instead, their producers and importers are required to compensate for 10% of the CO_2 emissions generated by burning these fuels through measures taken within Switzerland until 2020.

Examples of projects involving compensation for CO_2 emissions include the conversion of district heating networks from fossil fuels to waste wood or waste heat recovery and investments in the transfer of freight transport from road to rail.

Because fossil-thermal power plants emit large volumes of CO_2, the operators of such power plants must compensate in full for their emissions. At least half of the compensation must be provided through projects carried out within Switzerland.

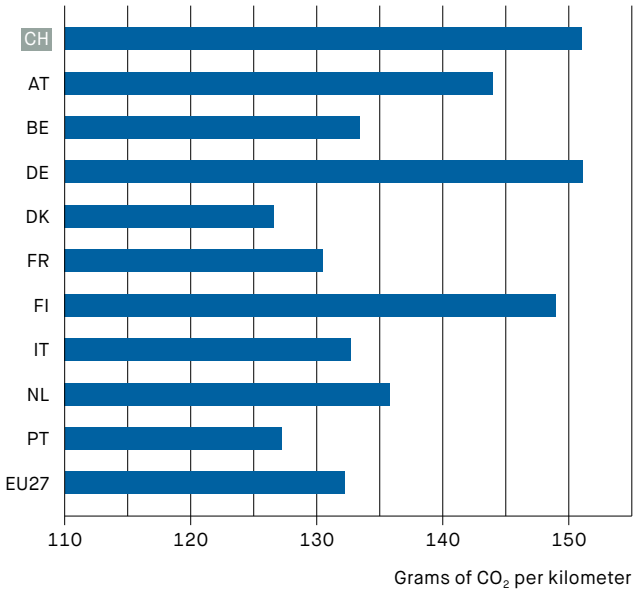
Swiss car importers are required to reduce the emissions from newly registered passenger vehicles to an average of 130 grams of CO_2 per kilometre by 2015 (→ ***GII.8.3***). If they fail to do this, they will have to pay a penalty. The target value was largely complied with in 2013 and the level of 'fines' collected was low (→ *SFOE 2014d*). For the post-2015 period, it is planned to tighten the emission target values and to extend the requirement to other vehicle categories.

The CO_2 Act also assigns the federal authorities the task of coordinating adaptation measures designed to prevent or mitigate climate damage. In 2012, the Federal Council passed the first part of its adaptation strategy, in which the objectives, challenges and fields of action for adapting to climate change are identified (→ *FOEN 2012a*). Based on this, an action plan was developed with measures to be taken at federal level (→ *FOEN 2014e*).

The key challenges in adapting to climate change include improving the knowledge base used when planning and implementing measures. To this end, the federal authorities are supporting research projects and implementing the Global Framework for Climate Services (GFCS), which was launched at the World Climate Conference of 2009, at national level. This should enable scientific findings on climate change to be processed so that they can be put to

View beyond the borders

GII.8.3 CO_2 emissions from new vehicles in Europe, 2012



Sources: EEA; auto-schweiz

Since 1 July 2012, CO_2 emissions regulations apply to newly registered passenger cars in Switzerland, as is the case in the EU. In 2012, the average emissions from Switzerland's new car fleet were 151g CO_2/km, which corresponds to fuel consumption of 6.2 litres per 100km. This means that Switzerland remains well short of the target value of 130g CO_2/km for the year 2015. One reason for the comparatively high emissions from new cars in Switzerland is that when purchasing cars, Swiss consumers show a preference for well-equipped cars with large engines, which have a high unladen weight.

Switzerland's international climate policy advocates the development of an effective and comprehensive global climate regime in accordance with the United Nations Framework Convention on Climate Change. Switzerland proposes ambitious and binding emission-reduction targets for all states.

practical use by public authorities, businesses and the general public.

To better assess the opportunities and risks associated with climate change in Switzerland, a broad-based risk analysis is being conducted. The damage and potential gains expected by 2060 in the impact areas of health, agriculture, forestry, energy, tourism, infrastructure and buildings, water management, biodiversity, and green spaces are being assessed in regional case studies. These studies will assist in identifying priority areas for action at national and regional levels.

Case studies have been completed for the cantons of Aargau and Uri. Further risk analyses are being conducted in the cities of Geneva and Basel and in the cantons of Fribourg and Ticino, and should be completed by mid-2016. A further analysis is planned for the Jura regions.

A pilot programme supported by several federal authorities was launched in 2013. The aim of this programme is to initiate innovative and exemplary projects for adaptation to climate change and to implement them by 2016 with financial support from the federal authorities.

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1 Kyoto Protocol to the United Nations Framework Convention on Climate Change of 11 December 1997 (with annexes), SR.814.011.

2 Federal Act of 23 December 2011 on the Reduction of CO_2 Emissions (CO_2-Gesetz), SR 641.71.

3 The individual greenhouse gases have different global warming potential. This is expressed as a multiple of the climate-warming potential of CO_2 in CO_2 equivalents (CO_2eq).

4 Ordinance of 18 May 2005 on Risk Reduction related to the Use of certain particularly dangerous Substances, Preparations and Articles (Chemikalien-Risikoreduktions-Verordnung, ChemRRV), 814.81.

5 Ordinance of 8 June 2007 on the CO_2 Levy (Verordnung vom 8. Juni 2007 über die CO_2-Abgabe, CO_2-Verordnung), SR 641.712.

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9 Biodiversity

Switzerland's biodiversity is in an unsatisfactory state. Over one third of all surveyed species are under threat, the area available for valuable habitats has declined considerably, and unique regional characteristics are being lost. The Action Plan for the Swiss Biodiversity Strategy sets out measures for conserving ecosystems in the long term, together with their species and the services they provide.

Context

Biodiversity encompasses the entire variety of life: the vast array of different habitats and ecosystems, of animal, plant, fungus and microorganism species, and of the genes that are found within each species. Thus biodiversity constitutes the basis for all living processes and ecosystem services.

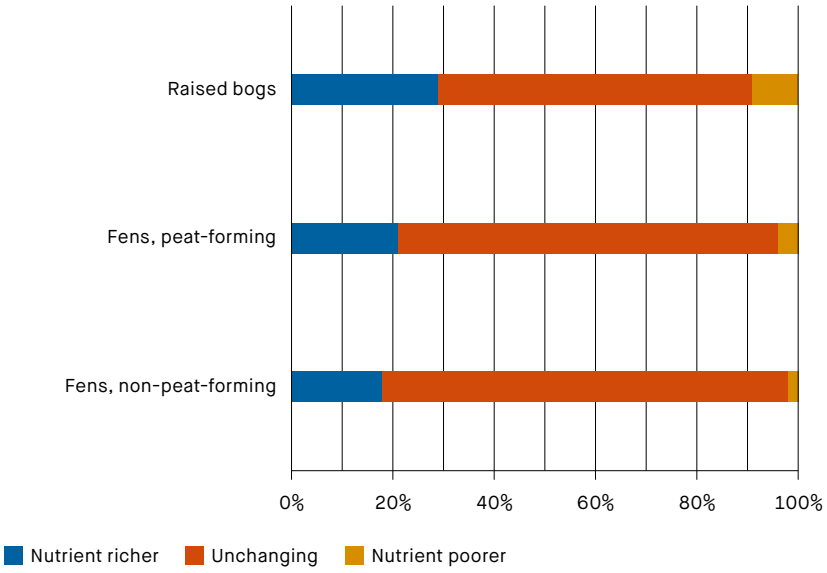
Switzerland's rich biodiversity has been shaped by natural factors, such as its geology, climate and topography, and by human activities in the areas of agriculture and forestry. Over the last 100 years, biodiversity has been under increasing pressure from intensified agriculture, soil sealing, hydraulic engineering structures, landscape fragmentation, pollutant contamination, the spread of invasive alien species and climate change.

Biodiversity in Switzerland is in an unsatisfactory state. In the 20th century, formerly widespread habitats, such as alluvial sites, mires, and dry meadows and pastures, shrank to a fraction of their original area. Around 230 types of habitat can be identified in Switzerland. According to expert assessments, between one fifth (uncultivated open land) and two thirds of all habitat types (wetlands and water bodies) are classified as endangered (→ *FOEN 2011b*).

Detailed studies on protected raised bogs, which are among the most severely threatened habitats, show that their ecological quality is in decline. In the raised bogs tested, nutrient contamination increased by 29% between the survey periods of 1997/2001 and 2002/2006 and an improvement was only observed in 9% of cases (→ ***G II.9.1;*** *FOEN 2007*). The species typical of raised bogs are reliant on low-nutrient conditions.

The loss of habitats (area) and their deterioration (decline in quality) mean that 36% of all surveyed animal, plant, lichen and fungus species are now

G II.9.1 Development of nutrient supply to mires and fens[a]



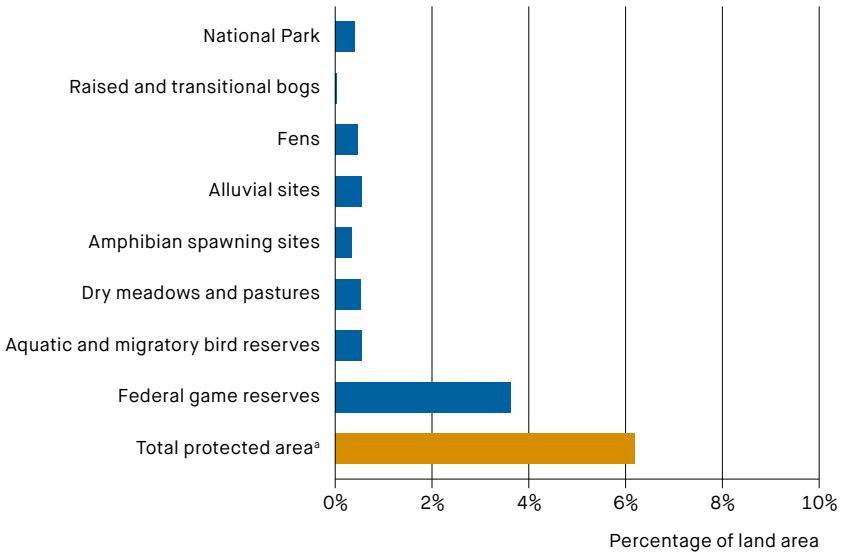
State: negative
The biotic communities found in mires rely on low-nutrient environments. Almost one third (29%) of raised bogs, 21% of peat-forming fens and 18% of non-peat-forming fens are affected by a marked increase in nutrients.

Trend: negative
An improvement in the situation may not be expected. Improvements can only be made at local level by creating buffer zones with sufficiently rich ecosystems.

[a] Between 1997 and 2006.
Source: FOEN


ATTENTION Sans contrôle, cette espèce peut nuire à la nature. Planter seulement sous
contrôle et dans les zones construites. Entretenir les plantes: tailler, ôter les fruits et les
graines. Ne pas composter soi-même; éliminer avec les déchets verts ou les déchets
ménagers. Art. 5 Ordonnance sur la dissémination dans l' environnement /
www.neophyten-envahissantes.ch

G II.9.2 Protected areas in Switzerland, 2013



State: negative

The protected areas set aside for the conservation of biodiversity only account for 2% of the national territory (according to the targets of the Convention on Biological Diversity (CBD), it should be 17%). Other protected areas (4%) are intended for the conservation of specific animal species.

Trend: neutral

One of the objectives of the Action Plan for the Swiss Biodiversity Strategy is to create an ecological infrastructure composed of protected areas and habitat corridors, with the aim of setting aside the space necessary for biodiversity to be conserved over the long term.

[a] Percentage of land area without overlaps.
Source: FOEN

threatened (→ ***G I.3***). The revised Red List of Threatened Plants documents a considerable decline in populations: around half of all locations with species in the highest endangerment category have been abandoned in the last 10 to 30 years (→ *FOEN 2013f*). At the same time, common species without specific requirements, for example the dandelion, are occupying ever increasing areas. Specific regional characteristics are lost through these adverse developments, habitats are becoming increasingly homogenous and the landscape more monotonous.

A detailed analysis of around 1,800 animal, plant, lichen and fungus species on the Red Lists identifies unfavourable changes in agricultural areas (over-frequent mowing and the use of unsuitable machinery, fertilisers, plant protection products etc.) and the loss of habitat structures (copses and hedges, forest margins, field margins etc.) as the most common causes of endangerment. Disturbances in the water balance (drainage) and work carried out on surface water bodies (straightening, canalisation, culverting) are identified as the third and fourth most common causes. Chemical and physical pollution (air pollutants, light), developments following the abandonment of land, and the complete destruction of the vegetation cover (sealing) are somewhat less common causes of endangerment (→ *FOEN 2011b*).

The biggest losses in biodiversity in cultivated land arose between the mid-20th century and the late 1990s. The areas most affected by this were the Central Plateau and large Alpine valleys. Incentives that were detrimental to biodiversity resulted in the intensification of agriculture, the drainage of wetlands and unification of plots. Hedges, dry-stone walls and other small structures that stood in the way of mechanised farming methods were removed, and the use of plant protection products and fertilisers (nitrogen, phosphate) was increased.

Excess ammonia, which mainly originates from agriculture, spreads through the air and results in the over-fertilisation of sensitive ecosystems. 100% of all raised bogs, 84% of fens, and 42% of the species-rich dry meadows and pastures are affected by excessive nitrogen inputs from the air. Species diversity in these habitats is declining as a result (→ *FOEN 2014f*).

As a result of correction measures and hydraulic engineering structures, watercourses have lost a large degree of their natural dynamics since the mid-19th century. Artificial barriers, dams and extreme surges and low flows (hydropeaking) downstream of hydropower plants diminish the ecological function and biodiversity of watercourses (→ ***Chapter II.11***).

Compared to other ecosystems, the level of biodiversity in forests is good. Since the 1980s, natural regeneration in forests has increasingly been the rule, and this encourages the growth of tree species suited to local conditions and a high level of genetic diversity. However, there are not enough old forests, forests with high levels of deadwood and well-lit young forests. The volume of deadwood in forests has increased in certain places in recent decades but major regional differences exist in this regard (→ ***Chapter II.14***).

Settlement and urban areas along with infrastructure areas continue to expand in Switzerland (→ ***Chapter II.6***), and the landscape is becoming increasingly fragmented (→ ***Chapter II.13***). Animals and plants are losing important life-sustaining elements as a result: habitats are shrinking or disappearing entirely in some cases and connections between them are being severed. The species populations and their genetic diversity are declining, and the risk of extinction is rising.

However, with suitable design and land use, built-up areas can provide space for an astonishing level of biodiversity. For example, in the city of Zurich alone, there are some 900 different animal species and over 1,200 plant species.[1]

Artificial light is one of the negative effects of urbanisation and can disturb the behaviour of nocturnal animals. Over the past 20 years, upward-directed light emissions in Switzerland have increased by 70% (→ *Federal Council 2012c*). Artificial light sources cause migratory birds to lose their bearings, kill insects and disturb the circadian rhythms of bats.

Increasing numbers of species that are not native to Switzerland are being introduced – in most cases unintentionally – and their populations are spreading. Invasive alien species such as the Basket Clam and Narrow-leaved Ragwort are proliferating and displacing native species.

Biodiversity is also under pressure from climate change. Species react differently to climatic factors such as temperature and humidity. With the expected changes in the climate, species' ranges can shift and existing ecosystem functions may be lost.

Impacts

The loss of biodiversity means that ecosystems are less able to provide important supply or regulatory services, such as protection against natural hazards and benefits to human health and well-being, and they become less able to respond to future changes. Ecosystems provide the economy with food, fabric fibres, construction materials and active components. They filter and store precipitation, allowing it to be used as drinking water, be it from springs or from the groundwater. Mires and wetlands absorb excess precipitation, forest ecosystems provide protection against rockfall, avalanches, landslides, and floods. Intact ecosystems, in which natural adversaries interact, help to regulate and contain pathogens and invasive species. The diversity of different habitats helps landscapes to maintain their individual character and attractiveness.

These and other services are threatened by the deterioration in levels of biodiversity. A loss of genetic diversity increases the risk of species extinction and reduces the capacity of species to adapt to changing environmental conditions. The loss of biodiversity makes it less likely that our future requirements will be met – for example in the areas of medicine, food, and material development. The capacity of ecosystems to respond to extreme events without losing their key functions is also dependent on the presence of animals, plants, fungi and microorganisms.

Switzerland needs not only its own biodiversity but also that of other countries. Industry, agriculture and research often use genetic resources from abroad to breed plant varieties and develop new drugs.

The costs of replacing ecosystem services with technical solutions or of restoring habitats are very high. This applies, for example, to drinking-water treatment, avalanche barrier construction, invasive alien species control and watercourse rehabilitation.

Measures

The ten objectives of the Swiss Biodiversity Strategy, which was approved by the Federal Council in 2012, have been substantiated in an Action Plan which is scheduled to be adopted by the Federal Council in 2015 (→ *FOEN 2012b*). As part of this process, measures have been developed on the sustainable use of biodiversity, direct subsidies and the

economic value of biodiversity, on generating and disseminating knowledge, and on Switzerland's international commitment to biodiversity. The measures are the result of a participative process involving actors from administration, business, science and interest groups. The measures are due to be implemented by 2020.

A strategy is also being examined that will give greater consideration to biodiversity in spatial-planning. This should help to create the required ecological infrastructure consisting of protected areas and habitat corridors (→ ***G II.9.2***).

The federal authorities are promoting biodiversity in the agricultural sector through the Agricultural Policy for 2014–2017, which was passed by parliament in 2013, (→ *Federal Council 2012b*). Biodiversity subsidies are being paid as an incentive for creating and maintaining biodiversity priority areas and improving the interconnection of these areas.

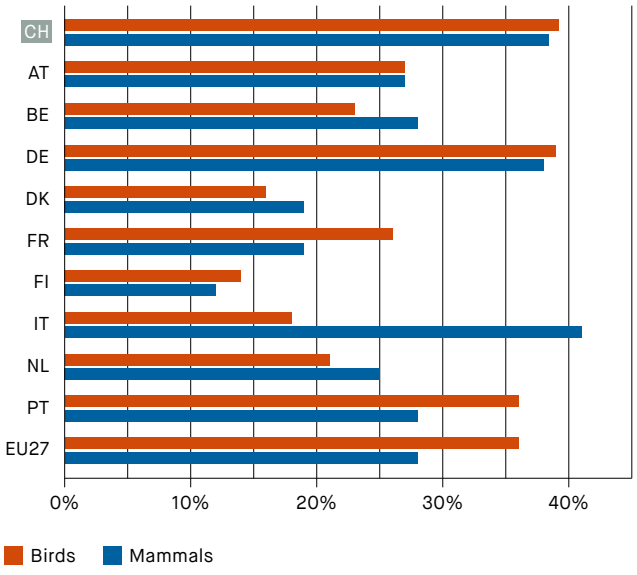
Under the water protection legislation, which was revised in 2011, funds have been earmarked to meet the cost of projects involving the rehabilitation of sections of watercourses which are in a poor ecological state.

The Forest Policy 2020, which was adopted by the Federal Council in 2011, includes the objectives of increasing forest reserves, which currently represent approximately 5%, to 8% of forest area, promoting priority habitats such as forest margins and wooded pastures, and ensuring that forest management in all forest areas is near-natural (→ *FOEN 2013g*).

The most important international agreement on the conservation of biodiversity is the Convention on Biological Diversity of 1992 (Biodiversity Convention[2]). A Strategic Plan for Biodiversity up to 2020 and a Protocol on the Access to Genetic Resources were adopted at the Conference of the Parties to the Convention in Nagoya in 2010. The Nagoya Protocol[3] regulates the equitable sharing of the benefits derived from the utilisation of genetic resources between industrial countries of the northern hemisphere and the biodiversity-rich countries of the South with their extensive traditional knowledge. Switzerland signed the

View beyond the borders

G II.9.3 Percentage of species classified as threatened in comparison with all known species[a]



[a] Most recent data available.
Source: OECD

Due to the gaps in the available data, it is difficult to compare the state of biodiversity in the EU with that in Switzerland. The available information shows, however, that species and habitat diversity in general are declining.

Switzerland is committed to implementing the global Strategic Plan and achieving the Aichi Biodiversity Targets 2011–2020 contained in the Convention on Biological Diversity.These include strengthening synergies between the biodiversity-relevant conventions and their instruments (e.g. global biodiversity indicators) and developing a coherent design for finance mechanisms.

Nagoya Protocol in May 2011 and ratified it through parliament in 2014.

1 www.stadt-zuerich.ch/content/ted/de/index/gsz/natuerliche_vielfalt.html

2 Convention of 5 June 1992 on Biological Diversity (Biodiversity Convention), SR 0.451.43.

3 Nagoya Protocol of 29 October 2010 on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits Arising from their Utilization (Nagoya Protocol).

10 Air

Air quality in Switzerland has improved steadily since the mid-1980s. However, current levels of particulate matter, nitrogen oxides, ozone and ammonia in the air are still harmful to humans and ecosystems. If the situation is to improve, the use of state-of-the-art technology must be made the norm.

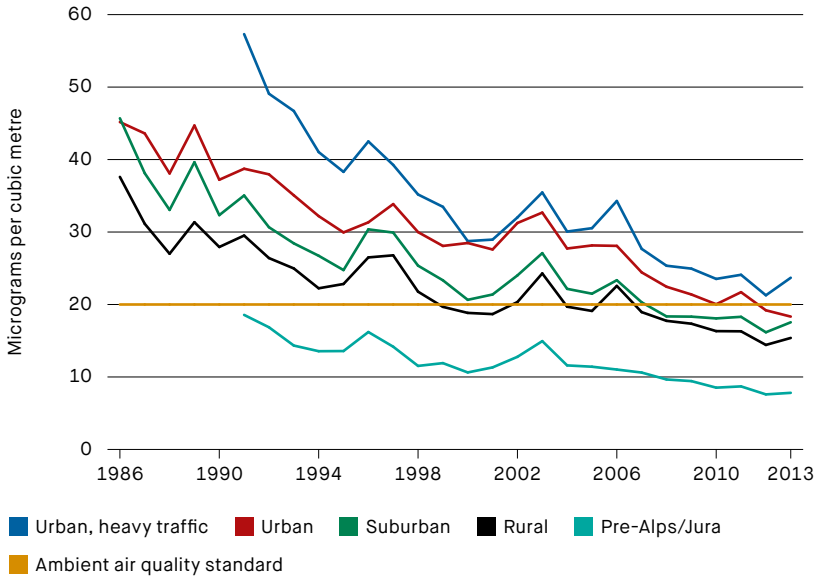
Context

Human beings inhale and exhale around 15,000 litres of air each day. If the air is contaminated with noxious gases and suspended particles, even in low concentrations, this can be harmful to health. Air pollution is usually at its highest level close to major sources of emissions. However, because the wind carries many pollutants over long distances, harmful emissions can also have an effect a considerable distance from their source. Moreover, pollutants can change or react with each other while on the move.

Air quality in Switzerland has improved considerably since the mid-1980s (→ *FOEN 2014g*). Sulphur dioxide concentrations and the lead content of particulate matter have now declined by around 90% at all measurement stations, and have been below the relevant limit values since the early 1990s. Today, the values for seven other important air pollutants, for which legally-prescribed ambient limit values exist, are also lower than the prescribed values in Switzerland today. This is not the case for three problematic pollutants: particulate matter (PM10), nitrogen oxides (NO_X) and ozone (O_3). The scale of ammonia (NH_3) pollution is also far in excess of the critical limit value (→ ***G I.4***).

Respirable particulate matter[1] is one of the main components of winter smog, which mainly occurs during periods of weather inversion in winter. Particulate matter is emitted in the exhaust gases of engines and heating systems, escapes during industrial and commercial production processes, and is produced through the wearing of brakes and abrasion of road surfaces; once released it swirls up into the air. Around half of the particles measured are only formed in the air from gaseous precursor substances, such as nitrogen oxides, ammonia and volatile organic compounds (VOCs). Slightly more than one quarter of particulate matter is produced by industry, agriculture and forestry, and transport. The rest is generated by households, mainly through the use of wood-fired heating systems (→ *FOEN 2014g*).

G II.10.1 Annual mean values for particulate matter (PM10)[a]



State: negative
The ambient limit value for PM10 in cities and on busy roads is still being exceeded.

Trend: positive
PM10 pollution has declined considerably in the last 25 years.

[a] Pre-1997 values calculated from TSP (total suspended particulates).
Source: FOEN

Particulate matter pollution in Switzerland has decreased since 1990 (→ ***G II.10.1***). The very high values for 2003 and 2006 were the result of increased emissions due to very cold weather conditions in combination with long periods of weather inversion. Concentrations in cities and urban areas prone to traffic congestion still exceed the ambient limit value, however; in rural areas, levels generally hover around the limits. At altitudes of over 1000m, the level is considerably lower than the limit value. Between 30% to 40% of the population are exposed to levels of particulate matter pollution that exceed the legal limit.

Nitrogen oxides are generated by burning motor fuels and combustibles in engines and heating systems. Together with particulate matter, they are a component of winter smog; however, in summer, they also contribute to ozone pollution as precursor substances. Traffic produces almost two thirds of nitrogen oxides, while around a quarter originate from industry and trade, and the rest come from agriculture, forestry and households (→ *FOEN 2014g*).

Nitrogen oxide pollution of the air has declined in most locations since 1990; however, the ambient limit value is exceeded along busy roads in cities and urban areas, in particular. Except for the major transport routes, levels are generally below the limit in rural areas.

Ground-level ozone in the form of summer smog is generated from nitrogen oxides, VOCs and other precursor substances in conditions characterised by high temperatures and intensive solar radiation. The highest ozone concentrations build up over long periods of fine weather. Because the precursor substances are transported over large distances, high ozone values are especially prevalent at medium altitudes, while the ozone in cities and along busy roads partially decomposes under the action of other pollutants. Industry, commerce and transport are the main causes of ozone pollution. Households, agriculture and forestry also contribute to this problem to a lesser extent (→ *FOEN 2014g*).

While levels of precursor substances have declined considerably since the mid-1980s, ozone pollution has not decreased to the same extent. This is due to the complex chemical processes involved in the formation of ozone and to pollution caused by contaminants, some of which originate from abroad. The ambient limit values are still being exceeded generally, and in some cases considerably, during smog periods in all parts of Switzerland. More positively, peak values have been attained somewhat less frequently over the past ten years.

In 2012, 93% of air pollution due to ammonia (NH_3) arose from agriculture, in particular livestock farming (→ *FOEN 2014d*). NH_3 escapes, for example, from buildings housing livestock and when spreading and storing farm manure in the open. Between 1990 and 2000, emissions of ammonia declined by around 10%; however, they have remained stable since then. The critical load limit for nitrogen inputs from ammonia and sulphur dioxide is exceeded in 55% of the area covered by all near-natural ecosystems (forests, dry meadows and pastures, alpine heaths etc.) (→ ***M II.10.1***). Around two thirds of these inputs arise from the ammonia emissions.

Impacts

Between 2,000 and 3,000 people in Switzerland die prematurely each year as a consequence of air pollution; of these, around 280 are victims of lung cancer. Year on year, poor air quality is responsible for more than 2,000 hospital admissions for cardiovascular diseases and respiratory disorders. Every year, the activities of over 4.5 million people in Switzerland are restricted by air pollution. The total health costs of air pollution exceed CHF 4 billion (→ *ARE 2014b*).

Particulate matter and nitrogen dioxide cause inflammation to the airways and damage the cardiovascular system. Particulate matter clogs the lungs and contains carcinogenic components such as heavy metals, soot and benzo(a)pyrene (→ ***Infobox "Wood-fired heating systems"***). Nitrogen dioxide increases the irritant effect of allergens.

Ozone irritates the eyes, nose, throat and lower airways. Persons affected suffer from tightness in the chest, coughing and reduced fitness levels. Ozone also inhibits the growth and vitality of sensitive plants, which results in harvest losses of up to 15% (→ *Fuhrer 1995*).

The input of nitrogen from ammonia and nitrogen oxides causes widespread over-fertilisation. In sensitive ecosystems, this results in the loss of animal and plant species that specialise in nutrient-poor conditions. Forests also lose stability because the roots of the trees fail to grow at the same pace as their parts above ground. Together with other pollutants, nitrogen

compounds cause the acidification of Alpine mountain lakes and forest soils. Nitrates from acidified soil can leach into the groundwater.

Buildings, cultural monuments and other structures and materials exposed to weathering become discoloured and damaged due to acidic air pollutants and ozone. Methane, soot particles, nitrous oxide and ground-level ozone also influence the climate.

Measures

The Environmental Protection Act (EPA)[2] requires the federal authorities and the cantons to protect human beings, animals and plants from air pollutants that are harmful or cause nuisance. The measures for achieving this objective are set out in the Ordinance on Air Pollution Control (OAPC),[3] the Air Pollution Control Strategy and various international conventions.

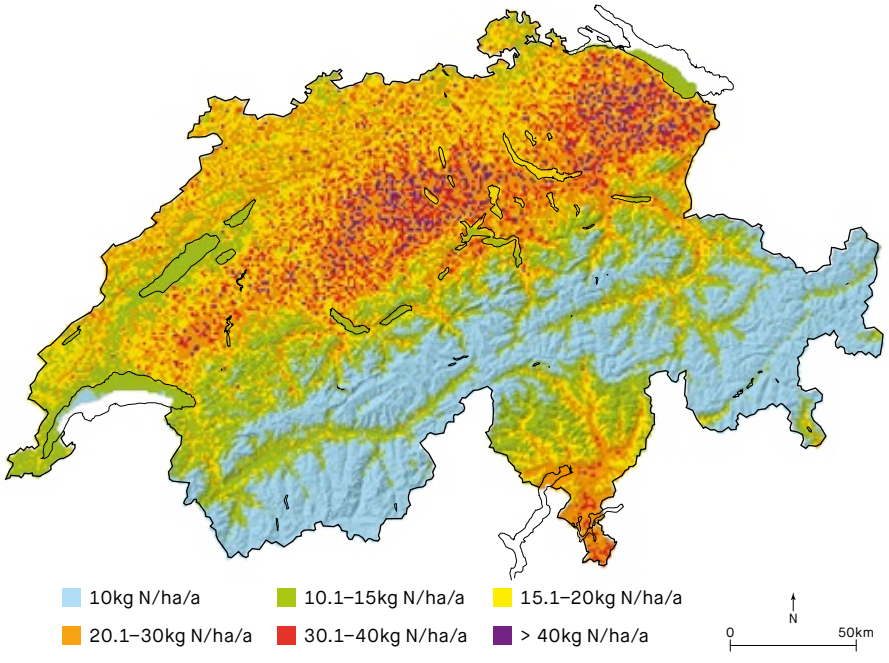
Persons or entities responsible for emitting air pollutants must first limit their emissions as far as this is possible and economically viable by using the best available technology. If harmful or disturbing impacts arise despite such measures, the authorities impose more stringent limits as a second measure.

The emission of pollutants from heating systems, industrial plants and motor vehicles can be reduced

Wood-fired heating systems

Air quality studies indicate that, even in cities, wood-fired heating systems are among the biggest sources of particulate matter pollution (→ *EMPA 2012*), even though they only account for around 4.5% of Switzerland's total energy consumption (→ *SFOE 2014b*). Especially high particulate matter values arise during calm weather inversion periods when pollutants in cold masses of air accumulate in valley locations. The carcinogenic particulate component benzo(a)pyrene has been measured in the Val Mesolcina village of San Vittore (Graubünden) since 2007 (→ *FOEN 2014g*). Benzo(a)pyrene is a chemical compound formed by the incomplete combustion of organic materials like wood. The values measured for the winter period in San Vittore are regularly up to four times higher than in the urban stations in Basel, Bern, Lausanne and Zurich. Small, manually operated wood burners and chimney stoves produce large volumes of particulate matter, especially if they are not used properly (e.g. by using cold or insufficiently dry wood, by igniting the stoves incorrectly from below, or by using them to burn waste illegally). Wood-fired power stations with efficient flue gas cleaning or modern high-tech pellet furnaces produce comparatively little particulate matter. The particulate matter emissions from oil and gas-fired systems are very low.

MII.10.1 Nitrogen inputs exceeding the critical load, 2010



Source: FOEN

State: negative

Nitrogen inputs from the atmosphere result in the clear exceeding of the critical limit over a wide area.

Trend: positive

Nitrogen deposition declined over the last 20 years.

considerably using technical measures, such as catalytic converters and filters. Switzerland has applied the European Union's (EU) emission standards for road vehicles since 1995. Starting from 2014, the EUR VI/6 standards will be phased in for all new motor vehicles. Compared to their predecessors, these standards achieve a considerable additional reduction in the emissions of nitrogen oxides and particulate matter. Furthermore, stricter technical regulations apply to off-road machines (construction machinery, locomotives, emergency generators) in Switzerland than in the EU (depending on the type of machine).

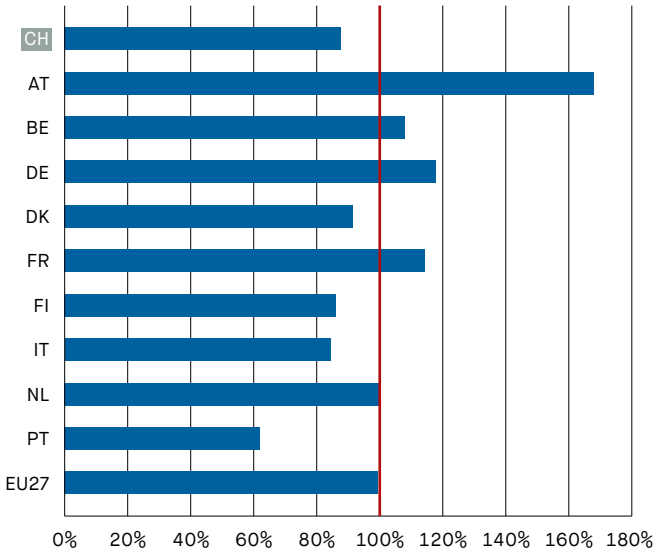
The federal authorities have imposed an incentive tax to reduce the emission of volatile organic compounds (VOCs). This instrument provides a financial incentive for industry, trade and households to be more sparing in their use of VOCs, and to switch to processes, substances and products that use fewer or no VOCs. Since 1 January 2013, companies can avoid the tax if they adopt measures that reduce their VOC emissions to below the legal requirements, for example by installing effective waste air purification systems. The federal authorities provide a further economic incentive mechanism with the heavy goods vehicle charge (HGVC). Under the HGVC trucks that are voluntarily retrofitted with particle filters or fulfil the stricter Euro VI standards in advance qualify for a reduced charge.

To reduce ammonia emissions from livestock farming, since 2008 the federal authorities have supported low-emission technologies, such as the use of trailing hoses to spread manure. Technical regulations on reducing emissions apply to the storage and treatment of farm manure, e.g. a requirement for better covers. Considerable emphasis is also placed on the low-emission design of barns and yards, and on keeping them clean. The shift from animal-based to area-based direct subsidies under the Agricultural Policy for 2014–2017 reduces the incentives for large livestock holdings and should also contribute to the reduction of ammonia pollution.

At international level, the Gothenburg Protocol[4] to Abate Acidification, Eutrophication and Ground-Level Ozone is the most important instrument for air pollution control. In addition to nitrogen compounds (nitrogen oxides and ammonia), the Protocol regulates VOCs and, since its revision in 2012, respirable particulate matter (PM2.5). While

View beyond the borders

G II.10.2 Nitrogen oxide emissions compared with the National Emissions Ceilings,[a] 2012



[a] National Emissions Ceilings in accordance with the Gothenburg Protocol.
Source: CLRTAP

The comparison of nitrogen oxide (NO_x) emissions with the national emission ceilings specified in the Gothenburg Protocol shows that these targets had not yet been attained by several of Switzerland's neighbours in 2012. An important reason for this was that the reduction in road traffic emissions in these countries was lower than expected due to their higher proportion of diesel vehicles. With the Euro VI/6 standards, which will be gradually introduced for motor vehicles from 2014, reductions in emissions of NO_x should be considerably higher than under the previous standards.

The UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) has eight protocols on the reduction of air pollutants. Switzerland has ratified all of the protocols and the FOEN is actively involved in the various CLRTAP bodies.

further major emission reductions are planned for nitrogen oxides and VOCs, those planned for ammonia will be less stringent.

1 Often abbreviated as "PM10" and "PM2.5". "PM" refers to "particulate matter" and the number refers to the diameter of the particles in micrometres.

2 Federal Act of 7 October 1983 on the Protection of the Environment (Umweltschutzgesetz, USG), SR 814.01.

3 Ordinance on Air Pollution Control of 16 December 1985 (Luftreinhalte-Verordnung, LRV), SR 814.318.142.1.

4 Protocol of Gothenburg to Abate Acidification, Eutrophication and Ground-Level Ozone as annex of the Convention of 13 November 1979 on Long-Range Transboundary Air Pollution (Geneva Convention), SR 0.814.32.

11 Water

Water quality in Switzerland has improved considerably since the 1950s. Plant protection products and other micropollutants still pose a challenge, however. For this reason, Switzerland is planning to develop its wastewater treatment plants by adding an extra treatment stage. New rehabilitation projects must be added to those already under way so that the ecological functions of watercourses are restored.

Context

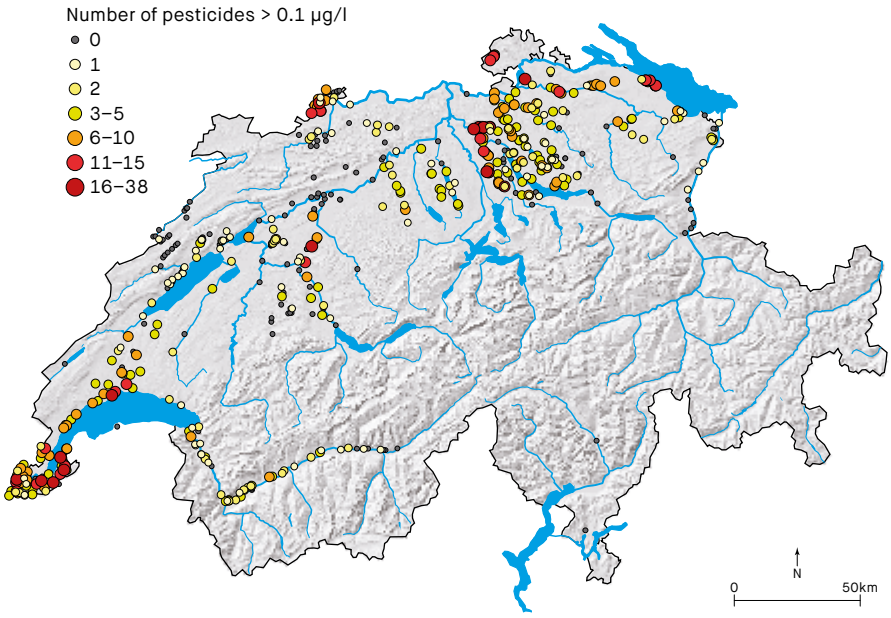
Switzerland's water bodies are used intensively. They supply drinking and process water, are used to produce energy, provide indispensable habitats for animals and plants, and enable people to enjoy high-quality recreation. The wide-ranging requirements of society and intensive agriculture pose a challenge to the quality of Switzerland's water bodies.

The quality of Switzerland's water bodies is generally good. However, groundwater and surface water quality is reduced by residues from fertilisers and plant protection products, and by components of personal care and cleaning products and drugs. These micropollutants can have an adverse effect on water quality, even in very low concentrations.

In many medium-sized and large rivers, the majority of micropollutants come from wastewater treatment plants (WTPs). Approximately 4,800km of Switzerland's 65,000km-long network of waterways are polluted with wastewater from these point sources. A first plant in Switzerland already has an additional purification stage for the removal of micropollutants. Around two dozen such WTPs already exist in neighbouring countries.

Diffuse sources are responsible for micropollutant impacts in smaller streams. This pollution can be severe and it is difficult to establish its direct source as it is usually brief in duration (a matter of hours to a few days) (→ ***G I.5***). Between 2005 and 2012, 565 sections of watercourses throughout Switzerland were tested for plant protection products and biocides, mainly by grab sampling: in 70% of locations, the pollutant concentration exceeded the values of 0.1µg/l stipulated by the Waters Protection Ordinance (WPO)[1] at least once. Concentrations exceeding 10µg/l were measured for 18 pesticides (→ ***M II.11.1***). In the majority of cases, the substances involved were plant protection products. The

M II.11.1 Micropollutants in surface water bodies based on pesticides, 2013



Source: FOEN

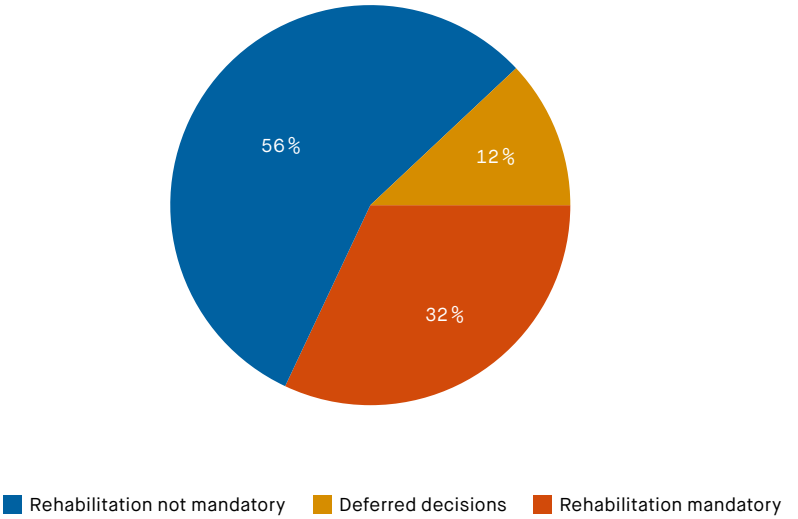
State: negative

The legal requirement is widely exceeded in watercourses; the associated impairment of the biological function of watercourses cannot be excluded.

Trend: positive

Thanks to measures for the reduction of inputs from diffuse and punctual sources, a reduction in the micropollutant contamination of watercourses may be expected.

G II.11.1 Rehabilitation requirement for fish passability, 2013



Only concerns obstacles caused by hydropower.
Source: FOEN

State: negative
Over 100,000 artificial obstacles hinder the upstream and downstream movement of fish.

Trend: positive
The rehabilitation of obstacles subject to rehabilitation by law in the area of hydropower will be carried out from 2015 (to 2030).

possibility of negative effects from these pesticides on aquatic organisms cannot be excluded.

Micropollutants from plant protection products are found in the water mainly due to surface run-off and leaching, incorrect practices (e.g. improper cleaning of spraying equipment and illegal disposal of residues), illegal use (e.g. use of herbicides along paths and roads), and wind transport from treated crops. The majority of plant protection products are used in agriculture.

Although the ground water quality in Switzerland is generally good – around 40% of the groundwater can be fed into the drinking water network without treatment – micropollutants from plant protection products, in particular, also pose a problem for groundwater. The legally required maximum value of 0.1µg/l is exceeded at around 2% of the National Groundwater Monitoring NAQUA sites. Degradation products from these substances are detected in concentrations exceeding 0.1µg/l at approximately 20% of the monitoring sites.

In addition to micropollutants, the concentration of nitrates in the groundwater is also problematic. They exceed the legal limit value of 25 mg/l at around 16% of monitoring sites (→ *FOEN 2009b*). Once they have reached the groundwater, foreign substances scarcely degrade at all – groundwater has an extreme 'long-term memory'.

Intensive construction activity is also problematic for the groundwater as, due to the associated progressive soil sealing, precipitation flows off the surface instead of seeping and feeding into the groundwater.

Switzerland's watercourses are extensively engineered and are limited in their natural functions. The numerous flood protection structures, energy production, and reclamation of land for agriculture and development areas have resulted in the structure of one quarter of all watercourses being in poor ecological shape, with reduced bed load budgets and fish migration (→ *FOEN 2009a*). Over 100,000 artificial barriers block the upstream and downstream movements of fish in streams and rivers. Rehabilitation is necessary in around half of all cases (→ ***G II.11.1***).

Not all watercourses are equally affected by these negative changes. At 52%, the highest number of watercourses with structures in an unnatural state is found in the Alpine valleys at altitudes below 600m. The corresponding figure for the Central Plateau is 38%, 36% for the Jura and just 15% in the Alps above the valley floors (above 600m).

Climate change, the discharge of warm water from cooling and water treatment plants, and the lack of bank vegetation for providing shade have caused the water temperatures in many watercourses to rise. For example, the Rhine in Basel is over 2°C warmer today than it was in the 1960s (→ ***G II.11.2***). The temperature of watercourses and their flow volumes over the year should continue to change in the process of climate change (→ ***Part III***).

Impacts

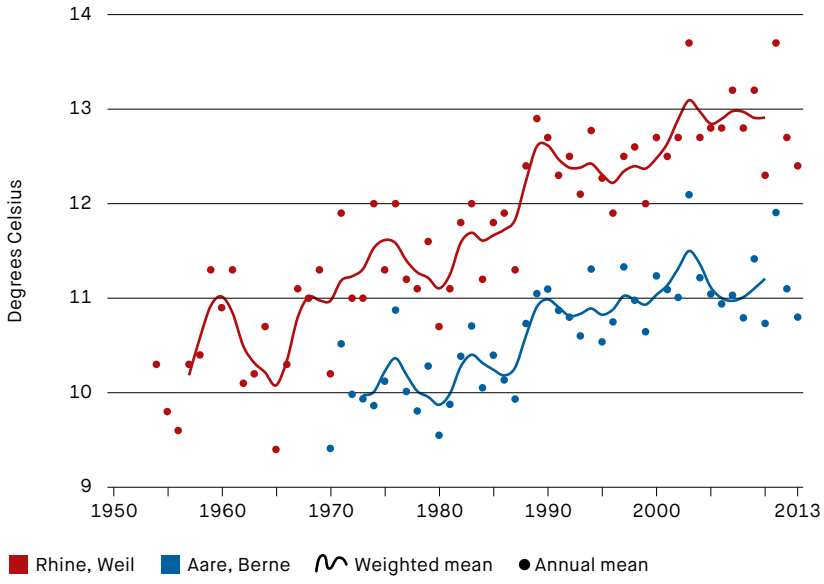
Even low concentrations of foreign substances in the groundwater can result in high economic costs for drinking-water treatment and the accessing of alternative groundwater wells. Water consumption in Switzerland has declined considerably since 1975. However, it is important to ensure in good time that the water requirement can still be met if consumption increases due to changes in demographic, economic or climate conditions (drinking water, water for fire-fighting, process water, including water for agricultural production) (→ ***Part III***).

In many watercourses, diffuse pollution by micropollutants exceeds the threshold above which they can be toxic to certain aquatic organisms. Micropollutants from WTPs and other point sources cause particular damage to the ecosystems in watercourses with a high wastewater content. Biologically active pesticides, pharmaceutical products or hormone-like substances can reduce the fertility and development of fish and other animals.

Hydraulic engineering structures and the lack of sufficient width for the watercourse along their banks severely limit connectivity and other ecological functions of watercourses. As a result, habitats become impoverished and biodiversity diminishes. Artificial barriers prevent fish from migrating. Where banks are concrete-lined or very steep, they limit the ability of animals in neighbouring habitats from moving around, and prevent interaction with neighbouring animal and plant populations. Dams, insufficient residual water volumes, and the operation of hydropower plants that have strong variations between surges in the water level and low flow (hydropeaking) also upset the natural dynamics of watercourses. As a result, water bodies – the original 'biodiversity hotspots' – are among the most severely impaired habitats (→ ***Chapter II.9***).

Hemmed-in watercourses do not have the space necessary to deal with flood peaks, thus more extensive damage must be expected if dams are flooded or break. Straightening and engineering also reduce the recreational value and landscape quality of many watercourses.

G II.11.2 Water temperature of the Rhine and Aare



State: neutral

Although water temperatures increased in recent decades, they are currently in a range that does not have any serious ecological or economic consequences.

Trend: negative

A further increase in mean air temperature and, hence also, an increase in the temperature of watercourses, is expected. This gives rise to negative ecological impacts, such as more frequent fish death events and a change in the species composition in watercourses. Economic consequences, such as reduced possibilities for thermal discharge (power plants), are also expected.

Source: FOEN

Less oxygen dissolves in water at higher temperatures (→ ***G II.11.2***). At the same time, the activity levels of animals increase and they need more oxygen. From 18 to 20°C trout, whitefish and grayling display stress symptoms and, in many cases, temperatures above 25°C are fatal to these species. In addition, certain diseases are more widespread in warmer water.

Measures

The federal water protection legislation aims to ensure that groundwater, the main drinking-water resource, is kept clean and free from long-lived artificial substances, even if these are not acutely toxic to humans according to the information currently available. Groundwater protection zones, the areas designated by the cantons around groundwater wells, are preventive in their effect and make an important contribution to attaining this objective.

If nitrate concentration exceeds 25mg/l in the groundwater, the cantons are required to develop rehabilitation projects, such as converting arable land into permanent pastureland – a measure that reduces the risk of nitrate leaching. However, this rule is not implemented consistently everywhere. Near-natural land-use, such as organic farming, can also reduce nitrogen inputs into the groundwater.

When licensing plant protection products, the authorities identify the risks that may arise for humans and the environment. If the risk exceeds an acceptable threshold, they refuse to license the product or only allow its use under additional conditions, e.g. maintaining a greater distance from surface water bodies when using such products. Previously licensed plant protection products are re-tested based on the latest knowledge, and the regulations on their use are adapted if necessary.

Other measures are required to reduce the pollution of watercourses with plant protection products. An action plan for reducing risks when using these products is currently under examination. The federal authorities are also testing measures for other substances, such as biocides, so as to reduce inputs from diffuse sources.

The approximately 800 WTPs in operation today remove nitrogen and phosphorous from the wastewater, but not micropollutants. If an additional treatment stage is added at around 100 selected WTPs, it will be possible to remove micropollutants from almost two thirds of all wastewater. The upgrading of the WTPs is expected to cost a total of CHF 1.2 billion. Spread across 20 years, this means an annual investment of CHF 60 million.

The federal water protection legislation makes provision for restoring the natural functions of streams, rivers and lakes and thus counteracting the negative impact of hydraulic engineering and straightening projects carried out over the past 150 years. This is a task spanning several generations and involving numerous synergies between water protection, flood protection, biodiversity and upgrading for the purpose of recreation. Designating sufficient space for water bodies, rehabilitating rivers and reducing the negative impact of hydropower production form an overall package of measures that is primarily implemented by the cantons and the owners of hydropower plants.

Of the approximately 14,000km of watercourse sections whose structure is in a poor ecological state,

Water resource use planning

Extensive periods of summer drought must be expected in Switzerland at local and regional levels (→ ***Part III***). As a result, intensive competition could arise between different uses (habitats for animals and plants, drinking-, process- and fire-fighting water, food production, energy generation, cooling, navigation, tourism and recreation) in certain regions. In the 2012 report, "Umgang mit lokaler Wasserknappheit in der Schweiz", ("Dealing with local water scarcity in Switzerland"), the Federal Council recommended that the cantons compile regional water resource use plans specifying measures that should help to mitigate such situations (→ *Federal Council 2012d*).

Conceivable measures include better networking between water suppliers, greater use of storage capacity, transfers from water-rich areas, more multiple use (cooling water, process water), increases in efficiency, the creation of collective savings incentives, and the development of participative management rules on how much water can be supplied, when and where.

The cantons and communes are best positioned to set priorities for the use of water. However, the federal authorities support the cantons in identifying risk areas and are drawing up practical guidelines.


T40
SkiArena

around 4,000km must be rehabilitated over the next 80 years (→ *FOEN 2009a*). The cantons completed the strategic planning for the pending rehabilitation projects by the end of 2014. Some projects have already started, e.g. on the rivers Wutach (Schaffhausen), Cassarate (Ticino) and Inn (Graubünden). However, the preparation of major projects takes a very long time. In rehabilitation projects, for example, banks are restored to a near-natural state and greater space is provided for the natural flow dynamics. The federal authorities are participating in the financing of such measures as part of programme agreements with the cantons and individual projects.

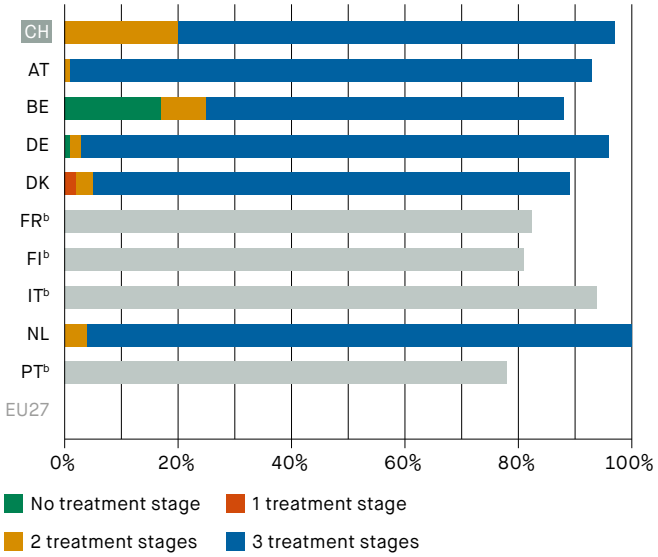
The cantons are required to safeguard the space necessary for water bodies by 2018 through suitable spatial planning instruments. The areas within watercourse corridors are classified as biodiversity priority areas; farmers are compensated when these areas have to be extended.

In Switzerland, there are approximately 1,500 extraction points for hydropower production. Around half of them require rehabilitation due to insufficient residual water volumes. In 1992, the Waters Protection Act (WPA)[2] stipulated that the rehabilitation projects had to be completed within a period of 20 years. This had not been achieved by 2012 in the majority of cases; however a further twelve cantons aim to reach the target by 2015. In the case of newly licensed hydropower plants, the residual water requirements are fulfilled in all cantons. Under the Waters Protection Act, the other negative impacts of hydropower production must be eliminated by 2030. The operators of the plants are compensated for the rehabilitation costs. The associated annual budget of CHF 50 million is covered by a surcharge on the transmission costs of high voltage power networks.

The Federal Council's Energy Strategy 2050 provides for the expansion of hydropower production by 2 terawatt hours (TWh) or 6% by 2035 (→ *Federal Council 2013b*). To ensure that the aim of increased hydropower production does not counteract the requirements of water protection, the cantons define in their protection or use strategies which sections of watercourses can be used for hydropower production, or locations where the protection of the watercourse takes priority. The federal authorities have issued guidelines on implement-

View beyond the borders

G II.11.3 Percentage of the population connected to a wastewater treatment plant based on the number of treatment stages[a]



[a] Most recent data available. [b] Connection level only, without differentiation by treatment stages. Source: EEA

Thanks to efforts made in recent decades, over 80% of wastewater undergoes a three-stage treatment process (physical, biological and chemical). 97% of the population is connected to one of over 800 central water treatment plants – wastewater is treated decentrally in the remaining 3% of cases. Switzerland has thus achieved the maximum possible level in terms of reducing the nutrient pollution of water bodies from household wastewater.

As a party to the UNECE Protocol on Water and Health, in addition to maintaining and safeguarding the existing infrastructure, Switzerland's main priority is to eliminate micropollutants from wastewater. Together with some of the German federal states (e.g. Baden-Württemberg), Switzerland has assumed a pioneering role in this area within Europe.

ing these strategies, such as their recommendations on how to devise cantonal protection and use strategies in the area of small hydropower stations (→ *FOEN/SFOE/ARE 2011*).

The problem of rising water temperatures is addressed in the federal authorities' climate change adaptation strategy (→ *DETEC 2012*). To reduce the increased flood risk, this strategy also requires that sufficient space be provided for water bodies. Regional water resource use plans offer a solution to the expected temporary local conflicts over the use of water in certain regions (→ ***Infobox "Water resource use planning"***).

1 Waters Protection Ordinance of 28 October 1998 (Gewässerschutzverordnung, GSchV), SR 814.201.

2 Federal Act of 24 January 1991 on the Protection of Waters against Pollution (Gewässerschutzgesetz, GSchG), SR 814.20.

12 Soil

Soil is not renewable and its limited availability is increasingly noticeable in Switzerland. Although soil pollution is declining and measures for the more careful use of soil have been introduced in agriculture and construction, the loss of fertile soil and its sealing through the construction of buildings, roads and other infrastructure continue unabated.

Context

The soil fulfils important ecological and economic functions: it is the basis for biodiversity and a means of production for agriculture and forestry, it stores and filters drinking water, reduces the runoff during heavy rain and flooding, supports groundwater recharge, and provides mineral raw materials. During heat waves, unsealed soil has a cooling effect on its surroundings. At the same time, the soil is an important CO_2 sink and, with careful management, makes an important contribution to climate protection. The nature of soil use also shapes the aesthetic qualities of the landscape.

The existence and functional capacity of the soil is under particular threat from the development of built-up areas. Although the expansion of such areas declined somewhat in the twelve years between the 1992/1997 and 2004/2009 land-use surveys compared to the preceding 1979/1985 period, at around 9% it remains considerable. Approximately 0.7m^2 of arable land is still being 'consumed' every second by the construction of buildings, roads and other infrastructure in Switzerland. A further 0.4m^2 per second is lost through bush and forest encroachment (→ *FSO 2013d*). A trend towards less settlement and urban area per capita and job can only be observed in regions characterised by large urban centres.

In 2009, over 60% of the built-up areas, or 4.7% of Switzerland's territory, was covered by buildings, roads and other infrastructure and, therefore, sealed. Between the land-use survey periods of 1979/1985 and 2004/2009, soil sealing in Switzerland increased by 29% (→ *FSO 2013d*).

At lower altitudes, built-up areas are expanding in the vast majority of cases at the expense of agricultural areas (→ *FSO 2013d*). In mountain regions, the structural change in agriculture has led to cultivated agricultural land being transformed into

F II.12.1 Development of heavy metal soil contamination, 1985–2009

	Cd	Zn	Cu	Hg	Pb	Ni	Cr	Co
Arable farming	→	↗	↗	↘	↘	→	→	→
Grassland								
intensive	→	↗	↗	↘	↘	→	→	→
low intensity	→	→	→	↘	↘	→	→	→
extensive	→	→	↘	↘	→	→	→	→
Forest								
Deciduous forest	→	→	→	↘	→	→	→	→
Mixed forest	→	→	↘	↘	↘	→	→	→
Coniferous forest	→	→	→	↘	→	→	→	→
Special crops								
Vegetables	→	→	→	→	→	→	→	→
Fruit	→	→	→	→	→	→	→	→
Vines	→	→	→	↘	↘	→	→	→
Others								
Protected site	→	↘	→	↘	↘	→	→	→
Urban park	↘	↘	→	↘	↘	→	→	→

Declining contamination Constant contamination Increasing contamination

Cadmium (Cd), Zinc (Zn), Copper (Cu), Mercury (Hg), Lead (Pb), Nickel (Ni), Chromium (Cr), Cobalt (Co).

Source: FOEN

State: negative

The contamination of soil with heavy metals remains high because these substances do not decompose. This poses a threat to human and animal health.

Trend: neutral

No general increase in heavy metal contamination can be observed. It was possible to stop the main sources of the contamination, e.g. lead in petrol and the spreading of sewage sludge. However, a strong increase in heavy metals can be observed in individual cases (e.g. in intensive fattening operations).


Désiré

forest. Particularly affected are Alpine pastures in summer grazing areas and species-rich meadows and pastures in the upper mountain zone.

Soil is also affected by the input of pollutants and by compaction and erosion. Pollutants from the air and the incorrect use of chemicals in agriculture and gardening can cause its pollution.

While levels of numerous other pollutants have remained stable, concentrations of lead and mercury declined in the top 20cm of the soil over the last 20 years. Increases in zinc and copper pollution are still being observed in intensively used soil and grassland fertilised with manure (→ ***F II.12.1;*** *FOEN 2014h*). This is due to the use of feed additives when fattening pigs.

In addition to the impact of soil sealing and pollutants, physical impairment is also a problem for soil. Soil compaction results from careless soil management, such as excessive pressure on the ground from heavy agricultural and construction machinery. Around 50% of intact soil consists of pore space, through which rainwater can trickle and plant roots can penetrate to considerable depths. When soil is compacted, the soil structure, including these spaces, is destroyed.

The risk of soil loss through erosion is influenced by gradient, soil properties, and the volume and intensity of precipitation. Open arable land and vineyards in valley and hill zones and on slopes in the mountain regions are at greater risk of erosion than other locations. Adapted management (e.g. multi-year temporary grassland, soil-conserving ploughing or permanent grassland in potentially endangered locations) can considerably reduce the risk of erosion.

Impacts

When soil is sealed or compacted, it loses its natural function as a habitat, sink and filter. Compacted soil allows water to run off its surface and increases the risk of flooding and erosion. Erosion destroys the fertile humus layer, releasing the CO_2 bound in the soil. Progressive development and the conversion of agricultural land is increasing Switzerland's dependence on natural resources from abroad for its food supply.

Heavy metals, persistent organic pollutants and other contaminants that accumulate in soil can inhibit soil metabolic processes, reach the food chain via plants, and thus harm human and animal health. Whereas air and water bodies regenerate if they are free of harmful pollutants for a few weeks or years, soil needs decades or even centuries to recover from pollutants.

Measures

The federal authorities are committed to conserving soil as a natural and life-sustaining resource. The economic management of soil poses a major challenge. Under the spatial planning regulations, the cantons must protect the best cultivatable arable land, i.e. land that can be used as crop rotation areas, and conserve a designated minimum of these areas.

The revised version of Switzerland's Spatial Planning Act (SPA)[1] was approved on 3 March 2013. The new SPA introduces stricter requirements for the dimensions of development zones. In addition, it creates incentives for the use of brownfield plots within development zones before new land is developed. The aim is to encourage high-density urban development.

In the Ordinance on the Pollution of Soil (VBBO),[2] the federal authorities require the soil to be managed during cultivation and construction in a way that ensures that it does not suffer any permanent damage. The federal authorities and cantons have developed a series of instruments and implemented preventive measures in cooperation with the construction, agriculture and forestry sectors. These include: training construction supervisors in soil science so they can then advise the developers of major construction projects on soil matters; issuing technical guides on protecting the soil on construction sites; and making more use of new soil-conserving cultivation methods in agriculture.

To protect the soil against pollution, preventive measures are supported by regulations (e.g. on the cadmium content of fertilisers and copper content of plant protection products). In addition, the federal authorities are examining whether consultancy and information services could be offered to reduce the risks to soil and water bodies from the use of plant protection products.

To ensure that the soil can fulfil its vital functions, what is needed is sustainable and integrated resource management that takes all of the functions

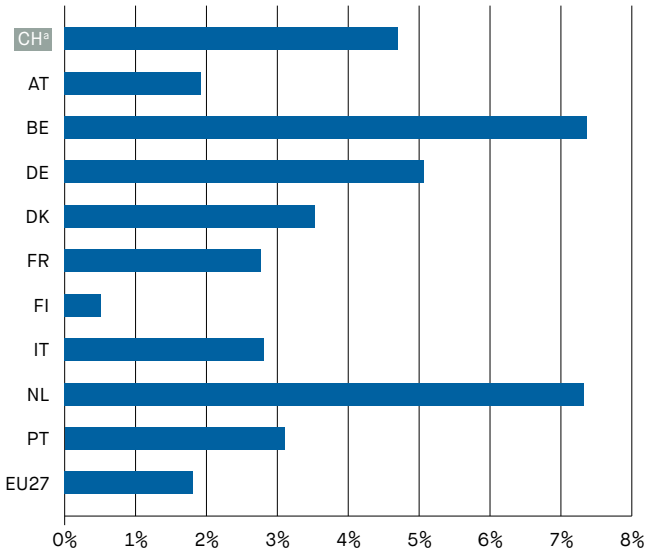
of the soil into account and distributes the available resources optimally. This kind of integrated protection/use strategy, which combines the qualitative and quantitative aspects of soil use, has not yet been seen in Switzerland (→ *FOEN 2006*).

1 Federal Act of 22 June 1979 on Spatial Planning (Raumplanungsgesetz, RPG), SR700.

2 Ordinance of 1 July 1998 on the Pollution of Soil (Verordnung über Belastungen des Bodens,VBBo), SR 814.12.

View beyond the borders

G II.12.1 Percentage of national territories sealed, 2006



[a] Based on the FSO's Land-use statistics of 2004/2009.
Sources: EEA; FSO

Compared with other European countries, the percentage of Switzerland's surface area that is sealed is average. This is because around half of the country is covered by forest and the Alpine region, and these areas have a low population density. The highest levels of soil sealing can be found in European countries with the highest population densities.

Soil is an area that must be regulated nationally. Nevertheless, Switzerland is interested in exchanging information and experience with other countries, and thus cooperates closely with the European Union's Soil Data Centre. Furthermore, protecting the multifunctionality of the soil is highly relevant to the international regulations that exist in the areas of climate, biodiversity, desertification, water and forest.

13 Landscape

Switzerland's landscapes are extraordinarily varied and attractive. However, their quality is deteriorating due to the encroachment of built-up areas and transport routes and the associated urban sprawl and fragmentation. The value that the landscape contributes to our well-being, in lending identity to open spaces, making locations attractive and the other services it provides, is declining. For this reason, the landscape must be taken into account in all spatially relevant policy decisions.

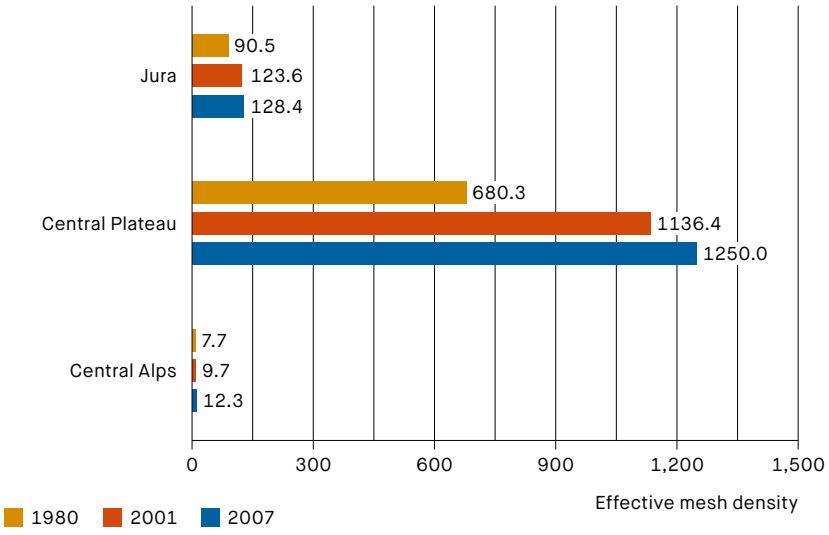
Context

Switzerland is characterised by an extraordinarily diverse range of landscapes. This is reflected in Switzerland's landscape typology which differentiates between 38 different extensive landscape types (→ *ARE/FOEN/FSO 2011*). The spectrum ranges from the urban cityscape to the glacierised mountains.

Landscapes fulfil wide-ranging biological, social and economic functions. Based on the requirements and expectations that people have of a landscape, it provides them with services – for example: as an economic and location factor; by reinforcing identity and as cultural heritage; for recreation and health; and as a space for biodiversity and the regeneration of natural resources. The quality of a landscape is measured by the extent to which it is able to provide these services (→ *FOEN/WSL 2013a*).

Driven by population growth, rising mobility, increasing demands in relation to living, energy and consumption, and the intensification of agriculture, the landscape in Switzerland underwent rapid change from the mid-20th century. At the time of the last land-use survey of 2004/2009, most of Switzerland was covered by productive agricultural land (36%) and forest (31%). Built-up area, a sector that has been increasing by 1% annually since the 1990s, accounted for around 8% of the country's land use (→ *FSO 2013d*) (→ ***G I.7***). The majority of new settlement and urban areas have been created at the expense of agricultural land, which declined by 2.2% between 1997 and 2009. At the same time forest has expanded at the expense of agricultural area in mountain regions, although in this case the process has mainly involved the encroachment of forests on summer pastures no longer used for agricultural purposes.

G II.13.1 Landscape fragmentation[a]



State: negative
The passability essential for the survival of various species is no longer guaranteed for the entire Central Plateau and valley regions. Infrastructure like motorways can present insurmountable barriers.

Trend: negative
The fragmentation of the landscape by new infrastructure and built-up areas continues to progress steadily.

The higher the effective mesh density (number of meshes per 1,000km²), the more fragmented the landscape.
[a] Roads (from motorways to driveways), railway lines, built-up areas, mountains over 2,100m, and lakes and rivers were taken into account as fragmenting elements.
Source: FOEN

The expansion of built-up areas and transport routes, and development zones that exceed demand in terms of size and, in some cases, are simply in the wrong location, results in the fragmentation of the landscape and in urban sprawl (→ ***Chapter II.6***). Landscape fragmentation is most extensive by some margin on the Central Plateau and least prevalent in the Central Alps (→ ***G II.13.1***).

In Switzerland, large areas without houses, roads, high-voltage power lines or other installations are really only found in the Alpine region. While such areas account for over 50% of the Central Alps, less than 1% of the Central Plateau has any infrastructure-free areas that are 0.25km^2 or more in size (→ ***G II.13.2***).

Other changes in the landscape result from new forms of management in agriculture, new tourism uses, and the harnessing of energy from hydropower and wind. Climate change is also causing changes in the landscape. Glaciers are melting, the tree line is getting higher and some areas are becoming unsuited to certain uses due to the increasing threat from natural hazards.

Impacts

The growing standardisation of buildings and other structures, architectural styles and agricultural methods in Switzerland means that the landscape is becoming increasingly uniform and losing its individual character (→ *FOEN 2010a*).

The sealing of the soil due to the expansion of built-up areas and transport routes is destroying soil fertility (→ ***Chapter II.12***), reducing the productive agricultural area, influencing the microclimate and damaging habitats. In addition, landscape fragmentation is making it increasingly difficult for animals and plants to move around or spread, and is, therefore, detrimental to biodiversity (→ ***Chapter II.9***).

The promotion of renewable energies as one of the objectives of the federal authorities' Energy Strategy 2050 may result in new conflicts that involve the landscape, in particular in landscapes and biotopes of national importance.

Upwardly directed light emissions are also increasing in Switzerland – by 70% between 1994 and 2009. The areas with natural nocturnal darkness declined from 28% of national territory in 1994 to 18% in 2009. There are no longer any areas on the Central Plateau and in the Jura region, in which it is completely dark at night (→ *Federal Council 2012c*).

Open spaces in the Limmattal urban landscape

A living network of open spaces is important for quality of life and biodiversity in densely developed urban landscapes. Open spaces are assuming greater significance in the context of targeted densification and urban development in existing built-up areas.

Working in cooperation with the regional planning associations and the cantons, nine communes in the canton of Zurich and eight in the canton of Aargau have developed an open space strategy for the Limmattal valley from Zurich to Baden, which is exposed to very high levels of traffic.

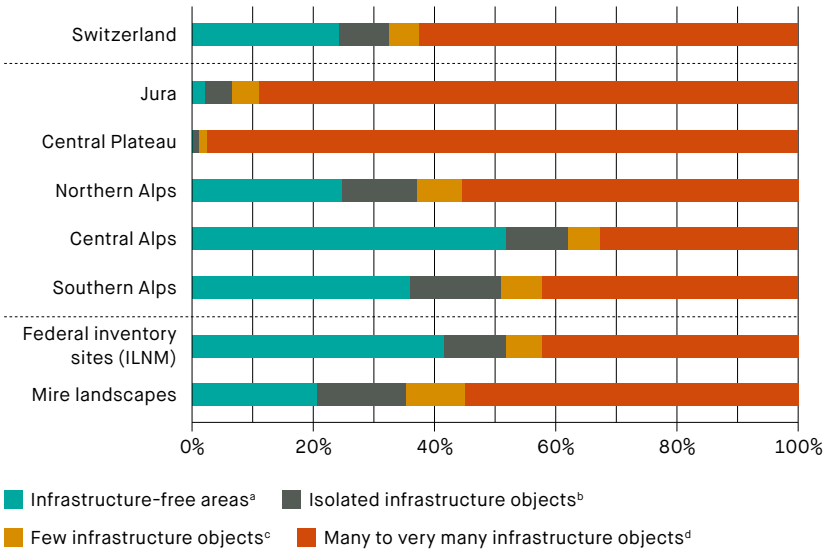
It is hoped that the "Limmattal Urban Park" will become an extensive network of open spaces. Its most important component is the "Blue Band" along the river Limmat with four valley-traversing paths. The open space strategy focuses on the valley area outside the development areas, but also takes the open spaces in the built-up area and the landscape quality of the hills into account.

Based on the various proposals, the first projects are now being implemented. These include continuous walking and cycling paths on both sides of the Limmat from Zurich to Baden.

Good cycling and pedestrian connections are not only an essential part of a special landscape experience under the heading of "Leisure and recreation on your doorstep", but are regarded as necessary and as creating opportunities for areas that want to be attractive to both residents and businesses.

The Limmattal urban park is one of 44 model projects that have been supported by the federal authorities through the provision of technical and financial resources. The purpose of model projects is to identify opportunities for achieving qualitative urban development within the existing areal limits including surface limits. With the third series of model projects launched in 2014, it will be possible to support projects in the five areas of development in existing built-up areas, open space development, supply of residential areas, provision of residential space and sustainable resource use.

G II.13.2 Percentage of infrastructure-free areas, 2009



State: negative
There are hardly any large coherent infrastructure-free areas, in particular in the Central Plateau and the Jura. Such areas are important, however, for the conservation of biodiversity and as leisure zones.

Trend: impossible to evaluate
There are no time series available, hence an assessment of the trend is not possible.

[a] That is, with no buildings, transport infrastructure, power lines, etc. [b] 0.1–5% of the 0.25km² reference areas with infrastructure.
[c] 5.1–10% of the 0.25km² reference areas with infrastructure. [d] Over 10% of the 0.25km² reference areas with infrastructure.
Source: FOEN

The attractive landscape is by far the greatest strength of 'brand Switzerland' for tourists (→ *Switzerland Tourism 2009*), who spent CHF 1.6 billion travelling to, from and within the country, and on food, accommodation and other purchases (→ *FEDRO 2011*). The quality of the landscape also plays a role in the quality of life and, therefore, in the property market. Tenants and prospective buyers prefer locations with views or close to lakes. The larger the size of the urban parks near houses and apartments and the nearer they are to infrastructure-free areas, the higher the rents they can yield (→ *FOEN/WSL 2013b*).

A survey carried out as part of a federal landscape observation study has revealed that Switzerland's inhabitants are likely to classify the landscape in their communes of residence as beautiful, unique and fascinating (→ *FOEN/WSL 2013a*). The evaluations of survey participants from rural areas are considerably more positive than those of people living in densely populated areas. Accordingly, the urban environment is the least positively evaluated by all population groups. It would appear that the rapid transformation of the landscape in recent decades has left its mark on the public.

Measures

Under the Nature and Cultural Heritage Act (NCHA),[1] the federal authorities are required to protect the landscape in their spatially-relevant activities (national roads, military installations etc.) and, therefore, to set a good example. An important instrument for this process is the Swiss Landscape Concept (Landscape Strategy for Switzerland, LKS), in which the federal authorities define binding targets for their nature and landscape protection activities, and introduce objectives and measures for the fulfilment of the individual sectoral targets (→ *SAEFL/FOSP 1998*).

In December 2012, the Federal Council mandated the Department of the Environment, Transport, Energy and Communications (DETEC) to update the LKS. The work is being coordinated with the other spatially-relevant federal strategies, i.e. the Swiss Biodiversity Strategy, Forest Policy 2020, the Spatial Strategy for Switzerland (Raumkonzept Schweiz) and Energy Strategy 2050.

The recommendations for the planning of wind energy installations, which the federal authorities have developed in collaboration with cantonal authorities, non-governmental organisations and the electricity sector, establish a basis for improving the landscape-compatibility of these structures

(→ *SFOE/FOEN/ARE 2010*). The cantonal structure plans must designate areas in which potential exists for wind energy and, conversely, identify areas in which other landscape services take priority.

The Agricultural Policy for 2014–2017 now allows the federal authorities to channel direct subsidies into conserving and improving landscape quality. This will enable the promotion of forest pastures, chestnut groves, mountain arable farming and other valuable regional landscape forms.

The Spatial Strategy for Switzerland (Raumkonzept Schweiz), which was adopted by the Federal Council, the cantonal governments, the Swiss Union of Cities and the Association of Swiss Communes, aims to promote inter-communal action arenas, improve the coordination of transport, energy and spatial development, and upgrade landscapes with their towns and villages (→ *Federal Council 2012e*).

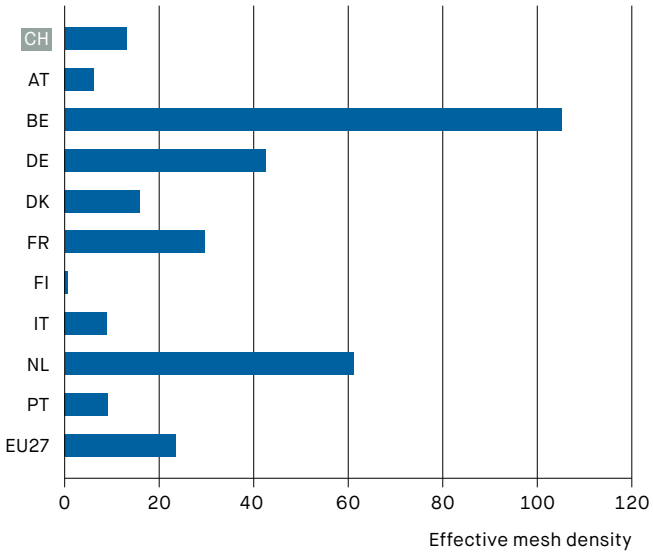
Open spaces like public green areas, city parks, squares, neighbourhood streets and the areas surrounding residential developments and industrial plants play a crucial role in upgrading built-up areas. The federal authorities have issued a practical guide which shows how the quality of open spaces can be improved in a targeted way (→ *ARE/BWO 2014*).

The federal authorities support the use of disused land (e.g. disused railway and military sites) in useful locations for building developments within urban areas, and provide an internet-based brownfield platform[2] that facilitates the rapid matching of demand and supply.

An agglomeration programme is a planning instrument which brings communes and cantons together for the coordination of transport and development projects beyond their administrative boundaries, and takes landscape factors into account. The federal authorities provide financial contributions for transport infrastructure through the agglomeration programmes. The second generation agglomeration programmes include requirements in relation to nature and the landscape (→ ***Infobox "Open spaces in the Limmattal urban landscape"***). To ensure the correct implementation of the programmes, nature and landscape factors are defined and supported by documentation. The intention here is to contribute to the upgrading of the landscape in built-up areas and to the long-term conservation of biodiversity.

View beyond the borders

G II.13.3 Landscape fragmentation, 2009



The higher the effective mesh density (number of people per 1,000km²), the greater the fragmentation of the landscape.
Source: EEA

Landscape fragmentation has increased in Europe over the past 30 years. The degree of fragmentation on the Swiss Central Plateau has almost doubled (taking 4th class roads into account); in other words, the landscape there is highly fragmented. Although the European comparison does not take the smaller roads into account, it does show that several countries are considerably more fragmented than Switzerland. The reason for Switzerland's comparatively better performance is the existence of relatively extensive unfragmented areas in its Alpine region.

Switzerland ratified the European Landscape Convention in autumn 2012 and it came into force here on 1 June 2013. It is based on a holistic understanding of the landscape, and focuses on including landscape considerations in sectoral policies and other socially important areas (communication, education, research, business).

Landscapes that are particularly worth protecting are recorded in inventories: the Federal Inventory of Mire Landscapes of National Importance provides comprehensive legal protection for a landscape type that has become extremely rare (Art. 23a–d NHG). The Federal Inventory of Landscapes and Natural Monuments of National Importance (ILNM) records Switzerland's most valuable landscapes. The federal authorities have refined the descriptions and protection objectives for all 162 items in this inventory. This will make it easier for decision-making authorities to weigh up differing interests, and will enable such processes to be carried out in a more transparent way.

Switzerland bears international responsibility for its World Heritage Sites and UNESCO Biosphere Reserves. The promotional instrument of parks of national importance has been available since late 2007. There are 20 such parks in Switzerland: the Swiss National Park in the Engadin and two candidate national parks, 14 operational regional nature parks and two candidates, and one nature discovery park. Parks of national importance, which are awarded a label by the federal authorities and given targeted promotion, consciously adopt a sustainable development approach. This should be compatible with the nature and landscape values of the region and offer a perspective for both local people and future generations.

1 Federal Act of 1 July 1966 on the Protection of Nature and Cultural Heritage (Natur- und Heimatschutzgesetz, NHG), SR 451.

2 www.brache.areale.ch

14 Forest

Forests protect us from natural hazards and provide habitats for animals and plants. They produce wood and are an ideal place for recreation. At the same time, they are under threat from nitrogen inputs, harmful organisms and climate change. Demand for the different services provided by forests is increasing, particularly on the Central Plateau. Forest area continues to increase in the Alpine region. The federal authorities have responded to the wideranging challenges facing the forest with the Forest Policy 2020.

Context

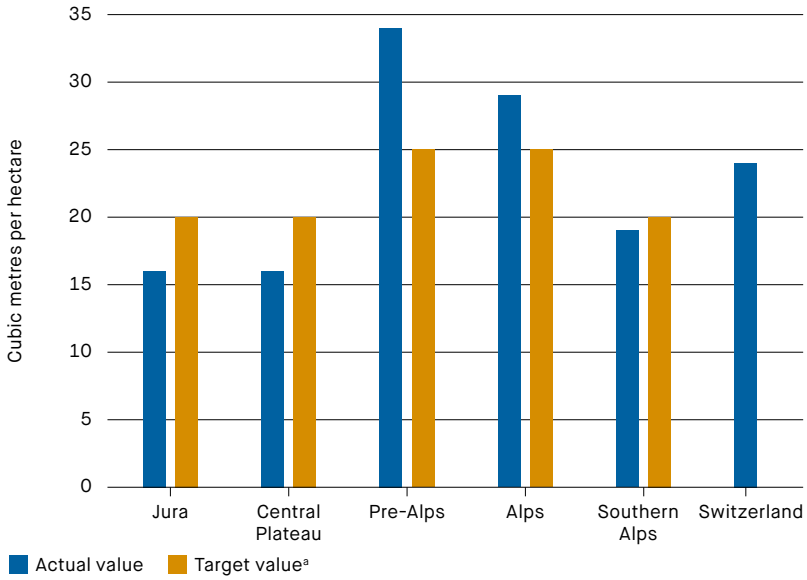
Forests cover 31.7% of Switzerland. Since the 19th century, this area has been expanding; between 1995 and 2013, it increased by around 823km^2 or 6.7%. However, major regional differences exist in the expansion of forest cover. While there has been no change on the Central Plateau and in the Jura, forest area in the Pre-Alps grew by 4.4%, in the Southern Alps by 11.6% and by as much as 13.5% in the Alps themselves. Due to the abandonment of farming activities, forest is gaining ground at altitudes above 1000m in particular.

Between 1995 and 2013, an average of around 7.3 million m^3 of wood was harvested annually, and a further 1.8 million m^3 was lost through natural mortality (→ ***G I.8;*** *WSL 2014*). At an average increment of 9.9 million m^3 per year, 0.8 million m^3 remains unlogged annually – mainly in forests that are difficult to access and in forest reserves. The federal authorities would like to increase Switzerland's annual wood harvest[1] (→ *FOEN 2013g*).

In the period between 1995 and 2013, standing volume throughout Switzerland increased by 3%. Major regional variations can also be observed: while the standing volume in the Central Plateau declined by 11%, it increased by 14% in the Alps and by as much as 29% in the Southern Alps. Insignificant increases were recorded in the Jura and Pre-Alps (→ *WSL 2014*).

At 49%, almost half of Switzerland's forest area is classified as protective forest (→ *FOEN 2013h*). To be able to provide effective protection against natural hazards, forests must be structured to serve a specific purpose and must be regenerated. The level of

G II.14.1 Volumes of deadwood based on production regions, 2013



State: neutral
The target values specified in the Forest Policy 2020 are exceeded in two regions, almost attained in one region and not attained in two regions.

Trend: positive
The deadwood volume has increased since 1995, in particular due to cyclones Vivian and Lothar.

[a] The target values are taken from the Forest Policy 2020.
Source: WSL, NFI 2009/13

regeneration in around one third of protective forests is critical or insufficient (→ *WSL 2010*).

Overall, more and more natural regeneration is taking place in Switzerland's forests. According to the latest surveys, the percentage of natural regeneration among forest stands in the regeneration and young stages increased from 81% to 90% between 1995 and 2013. When regeneration takes place in larger areas – usually in low-altitude forest – young growths and thickets occur. Between 1995 and 2013, the proportion of purely natural regeneration in these areas increased from 65% to 80%.

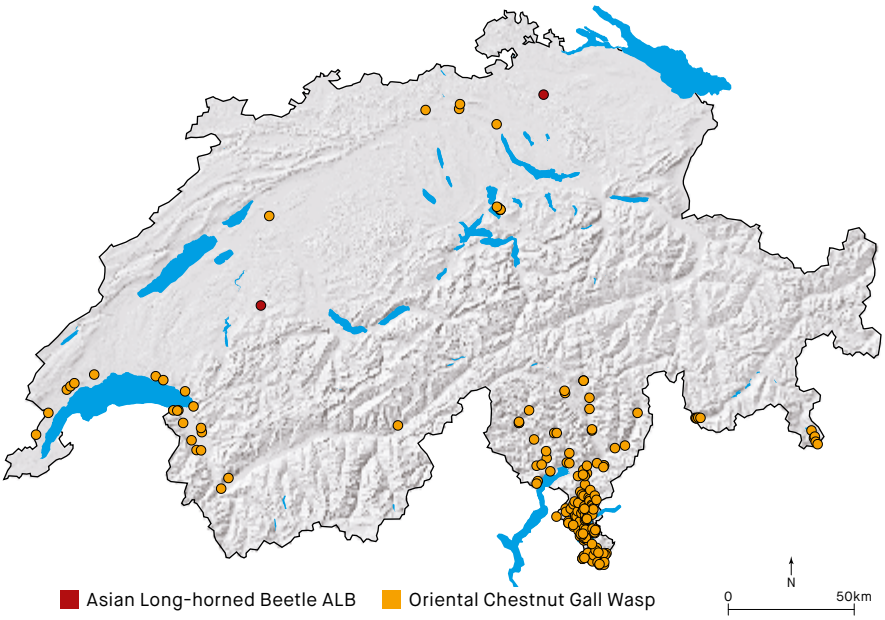
The volume of ecologically valuable deadwood rose from 11m^3 per hectare to 24m^3 per hectare between 1995 and 2013 (→ ***G II.14.1***). However, the figures for the Jura and Central Plateau are only around half as high as those for the Alps and Pre-Alps. The target values for deadwood specified in the Forest Policy 2020 are being attained in the Pre-Alps and Alps (→ *FOEN 2013g*). Over one third of all of Switzerland's animal and plant species are entirely or partly reliant on the forest as a habitat, and deadwood is essential for many of them.

The nitrogen inputs from the air, which mainly originate from agricultural ammonia emissions and nitrogen oxide emissions from road traffic, exceed the critical load threshold of 10 to 20kg of nitrogen per year and hectare in 95% of the harvested forest area. Depending on the location, these values are exceeded by a factor of over two. Over-fertilisation causes tree crowns to grow faster but does not provide the stronger roots that are needed for greater stability. Brambles are spreading and preventing natural regeneration in many locations. The Forest Policy 2020 aims to limit nitrogen input to a maximum of 20kg per year and hectare. The main sources of this pollution are agriculture and motorised transport (→ ***Chapter II.10***).

Climate change is leaving its mark on the forest and the associated impacts are already visible today. In the canton of Valais, for example, Scots Pine trees no longer grow on shallow and poor soils due to the increased stress from drought in recent years and are being replaced by Downy Oak. Tests have shown that the shift to higher summer and winter temperatures – coupled with biotic influences – plays a central role in this change in tree species (→ *WSL 2006*).

After extreme weather events, such as cyclone Lothar (1999) and the heatwave summer of 2003, harmful organisms such as the European Spruce Bark Beetle can cause enormous damage to trees. Between 1995 and 2005, 4.4 million cubic metres of spruce wood in the Pre-Alps fell victim to storms, while a further 3.7 million m^3 was lost to infestations of harmful organisms.

M II.14.1 Infestation of open land with harmful organisms that pose a particular threat to the forest (Asian Long-horned Beetle ALB, Oriental Chestnut Gall Wasp), 2013



Source: FOEN

State: negative
The infestation of wood with particularly dangerous harmful organisms can pose a threat to the forest and presents a challenge for forest protection.

Trend: negative
An increase in both species has been recorded in recent years.

The risk posed by the introduction of invasive alien species is also growing due to increases in imports and immigration (→ ***MII.14.1***). Since autumn 2011, open-land infestation by the Asian Long-horned Beetle (ALB) has been detected in two cantons. Under the Plant Protection Ordinance (PSV),[2] the ALB is classified as a particularly dangerous harmful organism as it affects very wide-ranging deciduous tree species and causes healthy trees to die within a matter of years. In addition, insects such as the Chestnut Gall Wasp, and invasive plants like the Tree of Heaven, fungi like *Chalara fraxinea*, which causes ash dieback, and threadworms like the Pine Wood Nematode require greater attention.

Impacts

The forests' potential for supplying domestic construction and energy wood is not being exploited to the full in Switzerland – the annual wood harvest is below the target value specified by the federal authorities (→ *FOEN 2013a*).

Switzerland exported around 816,000 cubic metres of raw timber in 2012 but imported only 170,000 cubic metres. Despite this, the foreign trade balance is negative: in 2012, wood and wood products to a value of CHF 2.4 billion were exported while the value of corresponding imports was CHF 6 billion. The relatively large volumes of exported unprocessed stemwood contrast with value-added-intensive imports of semi-finished and finished products (→ *FOEN 2013i*).

Forests protect built-up areas, transport routes and industrial installations from natural hazards such as landslides, avalanches and rockfall. A quarter of all Swiss transport routes (railway lines and roads) are potentially exposed to natural hazards (→ ***Chapter II.15***).

At less than 20%, the proportion of endangered species in the forest is lower than in other ecosystems (→ *FOEN 2011b*). The natural regeneration that prevails in forests today encourages considerable genetic diversity, and the increasing level of deadwood creates habitats for numerous animal, fungus, moss and lichen species which are reliant on deadwood for their survival. Dead trees that are still standing and very old trees are found in the late development stages of unharvested forests, in particular. They often contain nesting, breeding and hibernation holes and are populated by mosses, fungi and other organisms. Through increased and more targeted wood harvesting, well-lit forest can be developed that provide favourable conditions for thermophilic reptiles, rare butterflies and orchids.

The over-fertilisation of forests with nitrogen inputs from the air results in the acidification of the soil and, with time, this also affects the filter services that the soil provides. In some cases, technical drinking-water treatment may be needed.

The biomass growing in the forest removes CO_2 from the atmosphere. With the exception of the three years following cyclone Lothar in December 1999, the volume of carbon sequestered in this way exceeded the volume that was released from the forest through harvesting and natural decomposition. Hence, the Swiss forest functions as a CO_2 sink and contributes to climate protection. The replacement of energy-intensive building materials, such as concrete and steel, and the substitution of fossil fuels with wood also reduces Switzerland's CO_2 emissions.

Over half of the Swiss population visits the forest at least once a week in summer and one person out of three does so in winter. The average visit to the forest lasts one and a half hours. The forest's recreational uses are wide-ranging – walking, sport, relaxing, nature watching, picking berries and mushrooms etc. Following a visit to the forest, 95% of those surveyed reported that they feel more relaxed than they did beforehand. Dynamic activities such as cycling and mountain biking have increased, as have nature watching and other contemplative pastimes. Between 1997 and 2010, the numbers of people who felt disturbed by other leisure-seekers in the forest increased from 18% to 27%. Despite this, levels of satisfaction with visits to the forest are generally high (→ *FOEN 2013j*).

Measures

The Forest Policy 2020, which was approved by the Federal Council in 2011, sets out eleven strategic objectives. The areas of wood harvesting, climate change, protective forest services, biodiversity and forest area are identified as priorities. The majority of the objectives can be attained within the framework of the existing forest legislation (→ *FOEN 2013g*).

The Federal Assembly had already decided to revise the Forest Act in line with the Forest Policy 2020 in March 2012. The area under forest cover is funda-

mentally protected thanks to the ban on deforestation.[3] However, changes in the legislation have made the rules on deforestation and reforestation more flexible: when it is not possible to replace deforested stands in the same region, the authorities can require the implementation of compensatory nature and landscape protection measures instead.

Draft amendments to certain individual provisions of the Forest Act, on which the Federal Council carried out a consultation process, include amendments that will improve the control of harmful organisms, climate change adaptation and promotion of the use of wood (and, therefore, greater exploitation of harvesting potential).

Under the Forest Policy 2020, the consumption of sawn timber and timber products should be increased by 20% by 2015 compared with 2008. With the Wood Action Plan, the federal authorities aim to establish the sustainable supply and efficient use of wood from Swiss forests. The measures in this Action Plan include projects for the promotion of deciduous forest.

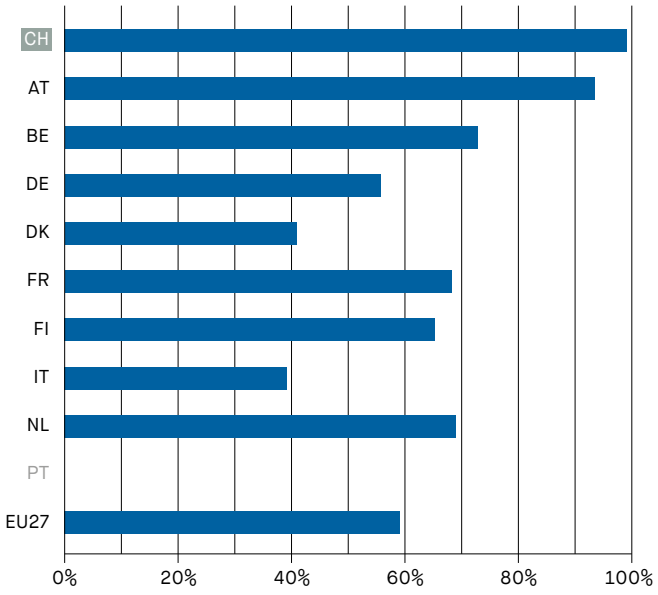
The federal authorities want to improve forest biodiversity, in part by increasing the proportion of forest reserves from the current 5% to 8% by 2020. These will include at least 15 forest reserves with an area of over 500 hectares (→ *FOEN 2013g*). In addition, the federal authorities support the maintenance of priority habitats such as forest edges and wooded pastures. The measures for promoting biodiversity are an integral part of the Biodiversity Action Plan, which is being drawn up as part of the Swiss Biodiversity Strategy (→ ***Chapter II.9***).

The CHF 60 million contributed by the federal authorities covers 40% of the cost of protective forest maintenance. The rest of the cost is borne by the cantons and the beneficiaries of the protection provided by forests (e.g. communes and public transport companies). The federal authorities define standard criteria for designating protective forests throughout Switzerland.

To ensure that the forest continues to perform all of its functions in the face of climate change, the federal authorities support research programmes that investigate how storms, periods of drought and forest fires affect the forest, and how native tree

View beyond the borders

G II.14.2 Wood harvest as a percentage of annual increment, 1990–2010



Sources: FOREST EUROPE; UNECE; FAO

The graph shows the wood harvesting rate (wood harvesting compared with net increment) for a selection of European countries. Due to the severe storm events (e.g. Lothar, end of 1999) during the period under consideration, the wood harvesting rates for Switzerland and Austria are exceptionally high. The latest data from the National Forest Inventory show that Switzerland's wood harvesting rate for the period 1993/1995 to 2009/2013 is 90%.

Switzerland advocates clear international regulations and conditions for the sustainable management of forests. It aims to ensure that countries discuss their experiences with each other, in particular in relation to new issues, such as the impact of climate change on forests.

species, for example the Silver Fir, are populating new locations. Working with the cantons, they also finance maintenance measures that lead to stable forest stands suited to their locations.

The federal authorities are drawing up various guidelines for the control of harmful organisms. The Swiss Federal Plant Protection Service (SPPS), which is jointly run by the Federal Offices for the Environment (FOEN) and Agriculture (FOAG), plays an important role in this process. Courses for forestry personnel, gardeners and other professions are complemented by classes that provide information about harmful organisms.

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1 The target value for wood harvesting specified in the Forest Policy 2020 is 8.2 million m^3 per year. However, this is calculated on a different basis to the aforementioned annual harvest of 7.3 million m^3.

2 Ordinance of 27 October 2010 on Plant Protection (Pflanzenschutzverordnung, PSV), SR 916.20.

3 Federal Act of 4 October 1991 on Forest (Waldgesetz, WaG), SR 921.0, Article 5.

15 Natural hazards

The risk posed by natural hazards in Switzerland is increasing, as is the the damage they cause. Built-up area is expanding and the intensity of its use is growing, including in areas at risk from natural hazards. Costly hazard protection structures alone cannot prevent the damage caused. Spatial planning measures and cooperation between the public and private sectors are assuming greater significance as a result.

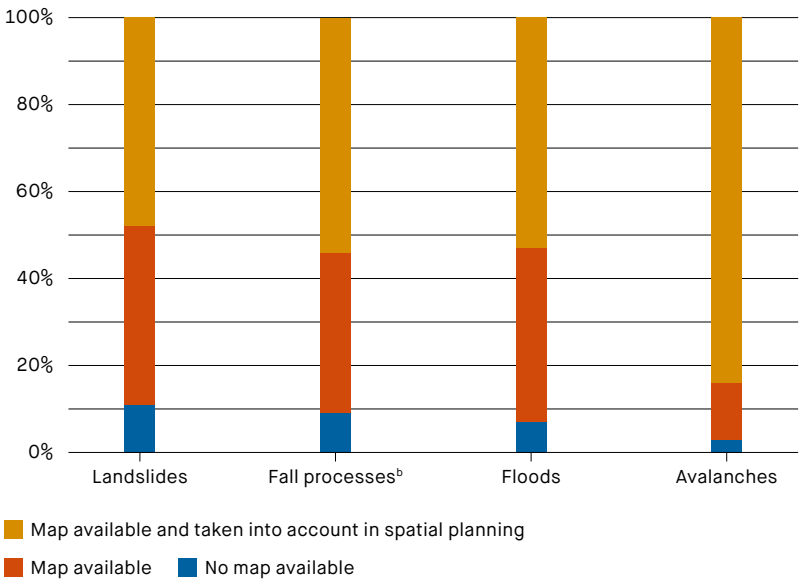
Context

Natural hazards, such as floods, debris flows, rockfall, landslides, avalanches and earthquakes, have shaped the social and economic development of Switzerland as an Alpine country for centuries. A considerable proportion of Switzerland's built-up area is threatened by natural events. Moreover, in some places, settlement and urban areas are expanding into critical areas and developed zones are being used more intensively. Many buildings and other material assets have become more vulnerable in recent decades (larger and ground-level doors, windows and light shafts, building services technology and expensive electronics in basements, underground garages etc.). The risk of damage is also growing due to the expansion of transport infrastructure and its more intensive use.

Climate change also increases the threat posed by natural hazards. This must be taken into account through prevention (→ ***Chapter II.8***). The increase in temperature has already caused the zero degree line to rise; as a result, the permafrost is thawing and new lakes are forming during glacier retreat, leading to flash flooding if and when they empty (→ *FOEN 2013e*). Intensive rainfall and other storm events can cause loose material to move, increasing the likelihood of rockfall and debris flows. This, in turn, causes greater volumes of bed load to accumulate in rivers and streams. More frequent heat waves and periods of drought intensify the risk of forest fires and protective forests are no longer able to fulfil their function effectively.

The risk of an earthquake occurring in Switzerland is average in the European context. Strong earthquakes up to a magnitude of seven are possible but much rarer than in high-earthquake-risk regions, such as Italy and Turkey. Of all natural hazards, earthquakes have the greatest damage potential and could occur anywhere in Switzerland. The asso-

G II.15.1 Hazard maps,[a] including their consideration in spatial planning, 2014



State: positive
90% of hazard maps had been compiled on 1.1.2014.

Trend: positive
The progress observed in recent years continues.

[a] Percentage of total Swiss land area mapped according to hazard type. [b] Rockslide, rockfall.
Source: FOEN

ciated risk is particularly concentrated in the major urban centres where population density and the value of material assets are high. From a long-term perspective, the earthquake risk in Switzerland is comparable to the flood risk; however, it can only be reduced through preventive measures in properties (earthquake-proof construction).

The federal authorities, cantons and communes have taken considerable steps in recent decades to protect the population, material assets and life-sustaining natural resources against natural hazards. As a result, the damage caused by natural hazards is not increasing on a scale that might be expected in view of the spread of settlement and urban areas and the rising intensity of land use.

Impacts

Floods, debris flows, avalanches, rockfall and landslides have caused very severe damage in certain cases in recent decades. The average cost of such damage for the period 1972 to 2013 was approximately CHF 325 million per year. The floods of 2005 alone caused damage to the tune of over CHF 3 billion (→ *G I.9*).

In addition to the costs associated with remediating the damage caused by natural hazards, CHF 2.9 billion is invested in protection against natural hazards in Switzerland each year. Of this, CHF 1.7 billion is provided by insurance companies, private companies and households, and CHF 1.2 billion comes from the federal authorities, cantons and communes.

The early 1970s saw the end of a long period in which relatively little damage occurred. Since then, the number of natural hazard events has increased. Of the twelve major events that took place in this period, eight were the result of flooding. For example, the flood of October 2011 was unusual for this time of year: rapid snow melt combined with heavy precipitation caused numerous watercourses in the Bernese Oberland, Central Switzerland and the canton of Valais to reach maximum water levels in a very short period of time. Various railway lines and roads were flooded and became impassable.

Rockfall events, such as that which occurred near Preonzo (Ticino) in 2012, and landslides, such as that in Val Parghera (Graubünden) in 2013, pose a threat to built-up areas and transport axes.

Measures

The damage events of the past 20 years have prompted the introduction of measures other than hazard prevention alone. The federal authorities are encouraging the establishment of a more conscious culture of risk. The focus here is on an integrated

G II.15.2 Verification of storm warnings

Source: METEOSWISS

State: positive
At 13% for both missed and unnecessary warnings, the Federal Council's targets of a maximum of 15% and 30% respectively were fulfilled for 2013.

Trend: positive
The number of unnecessary warnings has decreased in the last ten years, in particular, and the number of missed warnings remains low.

approach to risks. Integrated risk management involves all of the affected stakeholders, and combines the different measures to protect against natural hazards – including prevention, response and recovery (regeneration).

Risks and damage can be reduced in a number of ways: with spatial planning measures, protective structures against avalanches, debris flows and floods, by maintaining protective forests, establishing emergency strategies, optimising cooperation between the responsible services, and issuing information and warnings in good time. However, it is not possible to provide complete protection against natural hazards.

The protective measures adopted in recent years have proved effective in many places. The flood relief tunnels in Thun (canton of Bern) and the structural measures on the river Kander in Kandersteg (canton of Bern) and on the river Lonza near Gampel/Steg (Valais) fulfilled expectations during the floods of autumn 2011.

The current priorities for action in natural hazard management include renovating and adapting existing protective structures, increasing protective forest maintenance, controlling the spread of built-up area, developing warning and alerting systems, and increasing the general public's awareness of natural hazards by providing better information (individual prevention, how to act in the case of a hazard occurring, reducing the vulnerability of buildings) (→ ***Infobox "Promoting individual responsibility";*** *FOEN 2011c*).

Many large protective structures built in the past are based on outdated knowledge about natural hazards and do not fulfil current and future requirements. The federal authorities support the cantons in constructing new protective structures and renovating existing ones. Along with numerous projects on smaller water bodies, major rehabilitation projects are under way on the Rhone, Alpine Rhine and Hagneck Canal. Old avalanche barriers must also be upgraded on a regular basis.

It is important to compile standardised nationwide documentation on natural hazards and the associated risks to provide a basis for many of these measures. The cantons are responsible for assessing which areas are under threat from floods, avalanches, landslides and rockfall. The results are presented in the form of hazard maps (→ ***G II.15.1***). These must be updated regularly, for example in response to new information gained from event analyses and improved climate and hydrological scenarios.

The identified risks are taken into account in the revision of cantonal structure plans and communal land-use plans are revised. Hazard zones are designated in these plans and the communes formulate building regulations based on them. The hazard maps also provide a basis for the planning new protective structures, the protection of buildings, emergency planning and awareness-raising among the general public. By the end of 2013, the cantons had compiled over 90% of their hazard maps, and two thirds of the communes took account of the information in their land-use plans.

A range of preventive measures can be implemented to provide protection against earthquakes. The most important of these is earthquake-proof construction. Despite the progress made over the past ten years, the implementation of earthquake-proof construction and renovation in Switzerland still requires considerable systematisation. The actors primarily responsible for this are the owners of buildings, their consultants and the cantons in accordance with their construction legislation. The federal authorities, in turn, are responsible for earthquake monitoring and

Promoting individual responsibility

The timely availability of clear and comprehensive information is extremely important when dealing with natural hazards. This is equally applicable to prevention and actual hazard events. On the newly created natural hazards portal ***www.naturgefahren.ch***, the federal authorities warn the public about potential hazards such as thunderstorms, floods, forest fires, avalanches and earthquakes, and also advise the public how to behave during such events. Information about past events is also available on the platform.

When people come to harm during natural hazard events or property is damaged, this often gives rise to considerable costs. For this reason, it is in everybody's interest for private individuals to pay greater attention to their own responsibilities and take preventive action to protect themselves and their assets (houses, garages, buildings technology, furniture and fittings etc.).

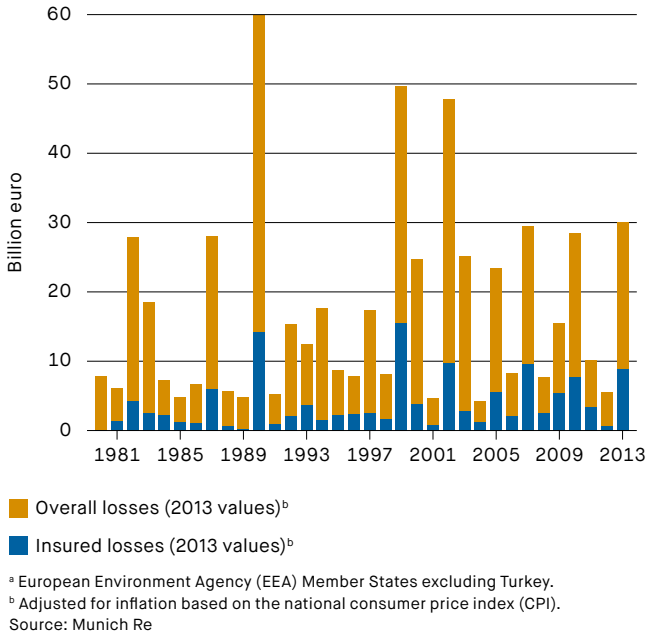
national hazard evaluation. They are also responsible for protecting their own buildings and facilities against earthquakes. In the event of an earthquake, they must provide subsidiary support to the cantons. In 2012, the Fournier motion required the Federal Council to develop a proposal for introducing mandatory earthquake insurance in Switzerland. The federal authorities commenced work with the insurance companies in 2013 and carried out an informal consultation process on proposals for this kind of nationwide earthquake insurance. It emerged from the consultation process that not all cantons are in favour of country-wide earthquake insurance, nor do they all support a solution based on an inter-cantonal agreement. Therefore, it is not possible to introduce national earthquake insurance with a standard premium on a federal basis at present.

Risks that cannot be controlled by means of spatial planning, protective structures, or the management of forests, watercourses and other ecosystems must be contained by means of comprehensive emergency planning (event prevention and management). The extent of the damage caused by major hazard events can be reduced by up to 20% with the help of improved forecasting methods and by warning and alerting the responsible federal and cantonal bodies promptly and correctly. As part of the Federal Council's mandate for the Optimisation of Warning and Alert in the Event of Natural Hazards (OWARNA, 2007 and 2010) and the partial revision of the Alarm Ordinance[1] (2011), the federal Specialist Natural Hazard Staff coordinates the procedure to be followed in the case of a hazard event. Thanks to improved cooperation between the federal authorities and cantons and the provision of better information, the flood of June 2013 was well managed. On this occasion, heavy rainfall caused a considerable rise in the water levels of rivers and lakes in the centre and east of the Central Plateau. The federal authorities with responsibility for natural hazards warned the cantonal and communal authorities about the heavy precipitation and the impending flood at an early stage so that the cantons and communes were able to take the necessary protective measures in good time. The public was also informed about the impending threat in good time.

The federal authorities and the cantons continue to develop warning systems that are adapted to local situations, for example by combining weather infor-

View beyond the borders

G II.15.3 Damages generated by severe weather events in Europe,[a] 1980–2013



[a] European Environment Agency (EEA) Member States excluding Turkey.
[b] Adjusted for inflation based on the national consumer price index (CPI).
Source: Munich Re

Storm damage appears to have occurred with increasing frequency in the period 1980 to 2013. Social change and economic development are the main drivers behind this increase. The change in the frequency and intensity of severe weather events may also influence the extent of the damage caused. However, it is not possible to state exactly how much of the increased damage can be ascribed to climate change. Adapting protective measures to the altered and increased requirements is, therefore, more important than ever.

Hazard prevention and risk management in the international context are areas that are gaining in importance for Switzerland. Switzerland aims to support less developed countries by exchanging knowledge and transferring technology for dealing with the consequences of climate change and natural hazards.

mation with information about geomorphological mass movements. This enabled the canton of Ticino to accurately forecast the rockfall event near Preonzo in 2012 within a margin of a few hours and manage it better as a result. This increased the level of safety attained.

The measures taken to improve the forecasting and warning systems used by federal natural hazard authorities have led to a continuous improvement in the reliability of the warnings. While the level of missed warnings has remained low, considerably fewer unnecessary warnings have been issued (→ ***G II.15.2***).

Preventing and managing natural hazard events and restoring affected areas in their aftermath are a joint task to be undertaken by the authorities, insurance companies and private individuals. Together with insurance companies and other stakeholders, the federal authorities have examined how this joint task can best be undertaken. This has given rise to an entire package of measures, which includes: greater risk dialogue, the search for solutions with regard to damage cover in the event of earthquakes, a joint training strategy for those responsible for natural hazards at all levels, closer cooperation between the public sector and insurance companies (→ *FOEN 2012c*), and the development of a nationwide, publicly accessible information platform on current natural hazards based on geodata (→ ***Infobox "Promoting individual responsibility"***). In addition, the use of construction methods which take account of natural hazards will be encouraged, and incentive systems to better protect buildings and other assets will be developed and proposed.

The federal authorities responsible for natural hazards operate the "Common Information Platform for Natural Hazards" (GIN) to facilitate the exchange of information and experience between experts from the federal authorities, cantons and communes. This gives safety experts rapid access to clearly presented expert information on natural hazard management.

1 Ordinance of 18 August 2010 on issuing Warnings, Raising the Alarm and Broadcasting Instructions to the Public (Alarmierungsverordnung, AV), SR 520.12.

16 Noise

Noise causes stress and can be harmful to health. In Switzerland, 1.6 million people, that is every fifth inhabitant, are exposed to harmful or disturbing road traffic noise during the day; 70,000 people are affected by excessive railway noise and 65,000 by excessive aircraft noise. Traffic noise generates costs of around CHF 1.8 million annually. The federal authorities are increasing the support provided for noise protection measures at source.

Context

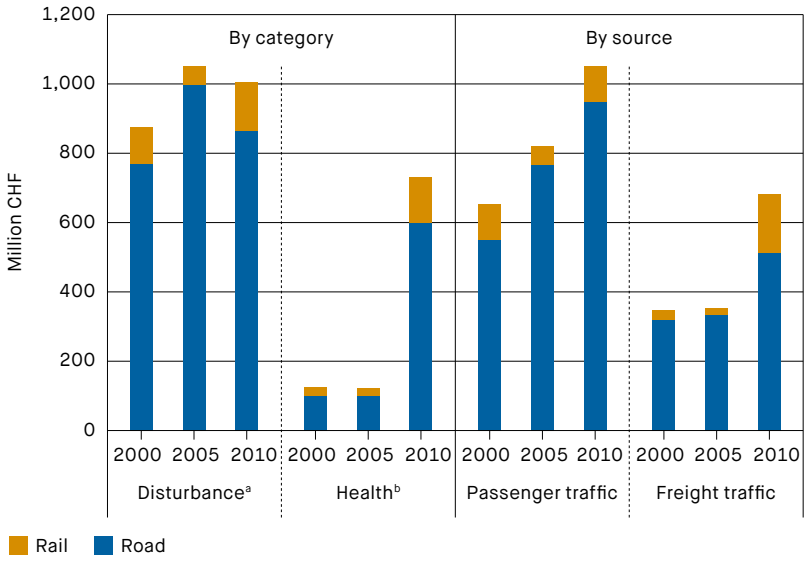
Quietness is a valuable good. It promotes human health and well-being and contributes considerably to the attractiveness of locations for working, living and leisure. The economic and social importance of a relaxing environment with natural sound levels can be clearly deduced from the property market and from the popularity of tourism amenities in near-natural landscapes.

Road traffic is the main source of noise in Switzerland. Much further down the scale come railway and aircraft noise. Noise is also generated by industrial and commercial plants, on building sites, and by machines such as lawn mowers and leaf blowers.

Over 1.6 million people – every fifth inhabitant – in Switzerland are affected by excessive traffic noise during the day; around 70,000 people have to cope with excessive railway noise. At night, 1.4 million or one in six people are affected by road traffic noise; in the case of railway noise, at 140,000 the number of people affected at night is double that affected during the day (→ ***G I.10;*** *FOEN 2009c, 2014i*). Despite the progress made in combating road noise, in many locations people are exposed to a greater noise impacts than 20 years ago. The main reasons for this include the growing volumes of traffic and heavier vehicles, which generate louder rolling noise with their wider tyres. The greatest impact from road traffic noise arises in urban agglomerations where 85% of the people affected by noise emissions live.

65,000 people are exposed to aircraft noise during the day; during off-peak nocturnal hours, the number increases to 95,000. The majority of the aircraft noise is concentrated in the areas around the biggest national airports in Zurich, Geneva and Basel-Mulhouse.

G II.16.1 External costs of traffic noise

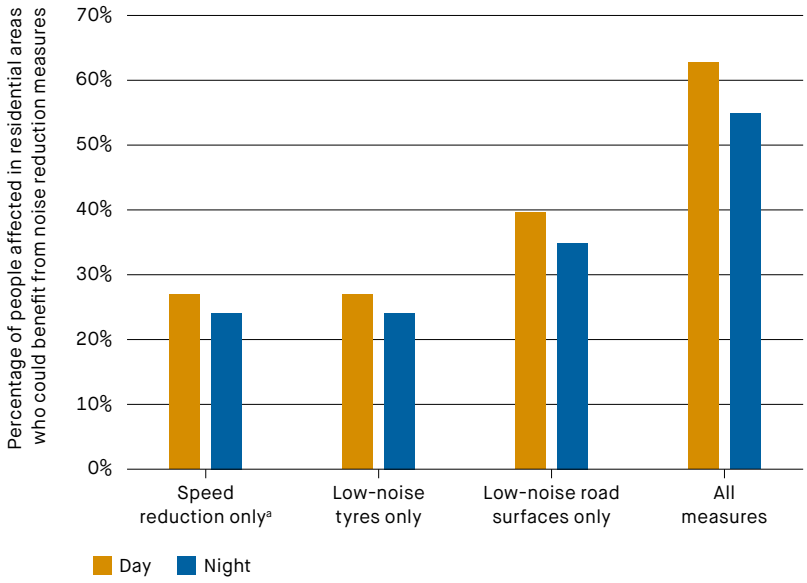


State: negative
A very high proportion of the costs generated by noise must still be borne by the affected persons and not by the polluters.

Trend: neutral
The external costs of traffic noise have remained constant in recent years.

New surveying methods and data sources result in higher noise costs in 2010, see ARE (2014b).
[a] Based on depreciation in property values. [b] Based on treatment costs and production losses.
Source: ARE

G II.16.2 Potential noise reduction measures in the road traffic sector



State/Trend: impossible to evaluate

Because the potential offered by the different measures is not good or bad a priori, the diagram is not evaluated.

[a] Speed reduction of 20km/h apart from main roads and extra-urban roads.
Source: FOEN

Between 1985 and 2009, the road network grew in area by 17% (→ *FSO 2013d*). Because the average daily traffic has increased each year, the noise generated on the roads has also spread, and now penetrates previously quiet areas.

Impact

Noise is harmful to health and general well-being. Elevated noise levels are disturbing, can cause stress and nervousness, disrupt sleep, and impair performance and concentration. Noise can lead to raised blood pressure, cause cardiovascular diseases and trigger social disorders such as aggression. Sick people, children and elderly people are considered risk groups for noise-related health problems.

Noise is responsible for high costs, which are only partly borne today by those who generate it. The external cost of road, railway and aircraft noise amounts to approximately CHF 1.8 billion per year (→ ***G II.16.1***; *ARE 2014b*). Approximately 40% of these costs arise from direct damage to health (especially ischemic heart disease and high-blood-pressure-related conditions: outpatient treatment, hospital stays, lost years of life etc.). The remaining 60% of the costs are accounted for by other negative impacts (measured on the basis of losses in property values). Road traffic is responsible for over 80% of noise-related costs.

According to an estimation method currently used by the World Health Organisation (WHO), the number of complaint-free years of life lost in Switzerland due to traffic noise – mostly on account of sleep disruption – exceeds 46,000 annually (→ *FOEN 2014j*).

In urban residential areas with high levels of traffic noise, less money is invested in the maintenance of houses and shops, a factor that further reduces their attractiveness in addition to the noise pollution. The social mix valued by many people is lost and neighbourhood and business life suffers. People with sufficient purchasing power move away to quieter neighbourhoods or to the country. The commuter traffic generated as a result generates additional noise in turn.

Measures

The Environmental Protection Act (EPA)[1] and the Noise Abatement Ordinance (NAO)[2] stipulate that people in Switzerland must be protected against harmful or disturbing noise. Noise protection measures should focus on reducing noise at its source so that disturbing noise is not generated to begin with. If this is not possible, noise can be contained by erecting noise barriers. As an initial measure, the noise to which residents on noisy streets or near railway lines are exposed can be reduced inside buildings, at least, by installing soundproof windows

and special air conditioning systems. The trend in Switzerland towards higher density housing construction, a growing population and increasing traffic levels means that it is all the more important to reduce noise at source in order to create residential and leisure areas that are pleasant from an acoustic perspective (→ ***Infobox "Protecting tranquillity and the quality of built-up areas"***).

With fixed installations such as roads and railways, noise reduction measures must be introduced if the legal noise exposure limits are exceeded. The federal authorities and cantons have set themselves the objective of protecting the population against excessive road traffic noise along the national, cantonal and communal roads by 2015 and 2018 by setting up noise-reduction programmes. The federal authorities already provided over CHF 2 billion for noise reduction measures on national roads up to 2012. It is estimated that over CHF 4 billion will have to be spent by the end of the noise reduction programmes. Up to now, the measures implemented have mainly involved the installation of noise barriers, the covering of some roads and soundproofing of windows (→ *FOEN 2013k*). Road noise can be further reduced by installing low-noise road surfaces, using low-noise tyres, speed limits and adapted driving styles, and by optimising traffic flows. If widely applied, these and other noise-reduction measures could lessen road traffic noise considerably and reduce the impact on a large proportion of the affected population (→ ***G II.16.2***). The extent to which these measures can be implemented must be examined on a case-by-case basis. In order to reduce noise at its source, the federal authorities have also been promoting the installation of low-noise road surfaces and the more widespread use of quieter tyres for a number of years.[3] A reduction of around five decibels[4] can be achieved using low-noise road surfaces alone, for example; this corresponds to a reduction in traffic of around two thirds.

By 2025, the federal authorities will have provided approximately CHF 1.5 billion for reducing railway noise. Since 2000, this funding has mainly been used for investments in better rolling stock, constructing noise barriers and installing soundproof windows. By 2015, rolling stock will be fully fitted with low-noise composite brake blocks. Loud railway carriages with grey-cast-iron brakes will be banned from 2020. As a result, technically obsolete foreign freight wagons will disappear from Swiss railway tracks. In promoting environmental technology, the federal authorities support the development of quiet, multifunctional low-loader freight wagons and solutions that dampen the noise of the tracks (rail grinding). Financial resources are earmarked for developing particularly low-noise rail vehicles and quiet technologies for infrastructure.

Thanks to international noise protection regulations and the corresponding technical advances, modern aircraft are considerably less noisy today than in the past. Restrictions on take-off and landing times, greater minimum flight altitude and adaptations to flight paths are the most important measures taken to reduce aircraft noise.

Reducing noise at source is being increasingly promoted by the federal authorities in the form of economic incentives. For example, the landing and take-off charges at Swiss airports are based on the noise generated by the aircraft. Since 2013, railway companies have received a reduction on track access charges based on noise emissions if they use quieter freight wagons. A further incentive system is being examined that would replace the current

Protecting tranquillity and the quality of built-up areas

According to a survey on "Perception of environmental quality and environmental behaviour" carried out in 2011 in Switzerland, 23% of the population perceive traffic noise heard at home with open windows as very disturbing or rather disturbing (→ *FSO 2012c*). High density housing, increasing urbanisation, greater mobility requirements and the development towards a 24-hour society are likely to exacerbate the problem of noise in the future. A Swiss study on noise-relevant future trends confirms that forward-thinking measures must be taken today to conserve the resource 'tranquillity' as an important location factor for living, business and recreation (→ *FOEN 2012d*).

Considerable investment is now made in visually upgrading neighbourhoods and cities. Despite the fact that sounds have a strong influence on our quality of life, insufficient consideration is given to the question of noise. Greater consideration should be given to reducing noise levels and improving the quality of sounds when planning and designing urban areas and buildings. Areas that are still quiet today and oases of tranquillity within walking distance of places of work and residential areas must be safeguarded.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highly complicated compensation system for losses in property value due to noise. One possible solution could involve the payment of regular compensation to property owners by noise polluters for noise-related losses in value. This would act as an incentive to the latter to reduce their noise emissions.

The federal authorities also encourage measures for the reduction of noise from machinery and equipment at source. For example, legal noise thresholds exist for a range of devices and machines and the maximum sound power level must be indicated on some of them.

1 Federal act of 7 October 1983 on the Protection of the Environment (Umweltschutzgesetz, USG), SR 814.01.

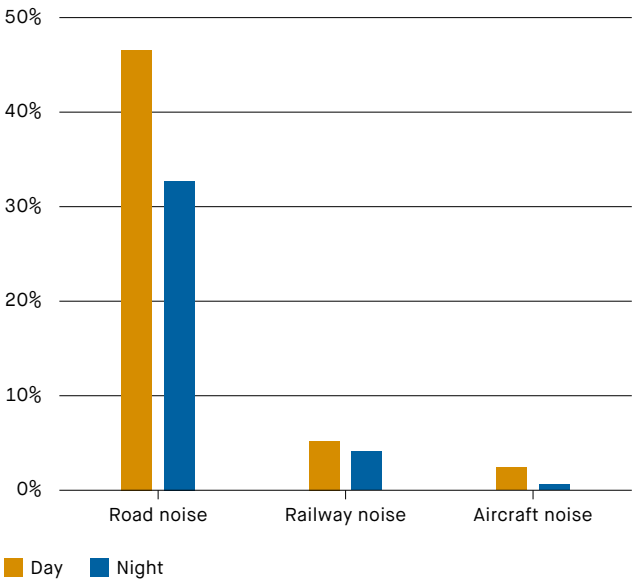
2 Noise Abatement Ordinance of 15 December 1986 (Lärmschutz-Verordnung, LSV), SR 814.41.

3 www.reifenetikette.ch

4 Physical unit for the measurement of sound, abbreviated as dB. For more information see: http://www.bafu.admin.ch/laerm/index.html?lang=en

View beyond the borders

G II.16.3 Population affected by noise in urban agglomerations in Europe,[a] 2012[b]



[a] EU Member States plus Norway and Switzerland. [b] Incomplete data.
Source: EEA

Road traffic is also the most important source of noise in Europe by a considerable margin. According to the European Environment Agency (EEA), almost every second resident in urban areas is exposed to road traffic noise in excess of 55dB. This means that these people are exposed to levels of noise pollution that exceed the level recommended by the World Health Organisation (WHO) for the general protection of human well-being and health.

Exposure to noise pollution is predominantly a local problem, which, however, has global causes. Noise emissions from individual vehicles (passenger cars, trucks etc.) are a key factor in the extent of this pollution. The maximum noise that may be generated by the different vehicle types is defined by international bodies. Switzerland is involved in the development of the corresponding decisions.

17 Electrosmog

The population's exposure to electrosmog is increasing. This is a result of new mobile communication applications and the adaptation of the high-voltage network to the requirements of the future energy supply. To evaluate the impact of electrosmog, a monitoring system is required which records the long-term development of radiation exposure and its influence on health.

Context

Non-ionising radiation – often referred to as electrosmog – is produced by the generation, transmission and use of electricity (low-frequency radiation) and by radio applications, such as mobile telephony, wireless networks (WiFi), radio and television transmitters, and radar (high-frequency radiation).

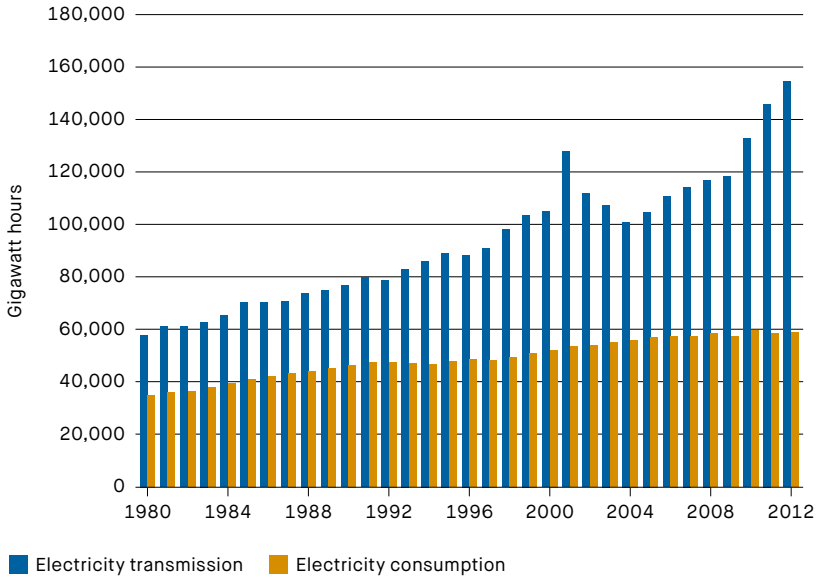
While operators and authorities are responsible for limiting the radiation emitted by infrastructure like high-voltage power lines and mobile phone antennae, each individual can influence the level of electrosmog through the responsible use of mobile and cordless telephones in the private sphere.

The use and spread of technologies that cause electrosmog is likely to increase in years to come. This also applies to high-voltage networks and mobile telecommunications.

Switzerland's ultrahigh-voltage (220kV or 380kV) electricity network spans around 6,700km; in addition, the high-voltage network (50–150kV) covers a distance of 9000km. As trading on the liberalised electricity markets increases and electricity accounts for a growing share of the energy supply, greater use is being made of existing electricity networks. This results in more electrosmog in the vicinity of these installations (→ ***G II.17.1***). Moreover, additional network capacities will be needed in future.

Mobile telephones have become extremely popular in recent years. Today, around 1.3 SIM cards are registered per capita in Switzerland. The use of the mobile communications network has increased rapidly with the growing availability of smartphones. Between 2008 and 2012, the volume of data transmitted by mobile communications increased by a factor of 24 (→ ***G I.11***). As a result, the electrosmog that can be measured in public areas is also increasing (→ ***Infobox "More electrosmog through mobile internet use"***). As this trend is likely to continue in

G II.17.1 Development of electricity transmission and consumption



Source: SFOE

State: neutral

According to the ambient and installation limit values specified in the ordinance on non-ionising radiation, exposure to low-frequency fields in the public space is still relatively low at present.

Trend: negative

Due to the more intensive trading on the liberalised electricity markets, the volume of electricity transmitted is increasing more than that consumed. The greater utilisation of existing power networks is synonymous with more electrosmog in areas close to these facilities.

future, greater consideration is now being given to low-radiation technologies.

Technical and structural solutions for the reduction of electrosmog exist for both electricity transport and mobile communications. The planned renovation and extension work on the Swiss high-voltage network provides an opportunity for reducing or, at least, preventing further increases in radiation for the affected populations by installing overhead power lines at a sufficient distance from built-up areas. If densely populated areas have to be crossed, the power lines can be laid underground; this will considerably reduce the spatial extent of the radiation compared to that emitted by overhead power lines. At present, only around 0.5% of ultrahigh-voltage lines are buried, while a good 20% of lines in the supraregional supply networks (50–150kV) are underground.

In mobile communications, microcells present a possible option for simultaneously reducing the radiation from both base stations and mobile devices. This concept involves the use of numerous small low-radiation antennae rather than a few antennae with high transmission power. Such networks are already in operation in the centres of Bern and Geneva.

More electrosmog through mobile internet use

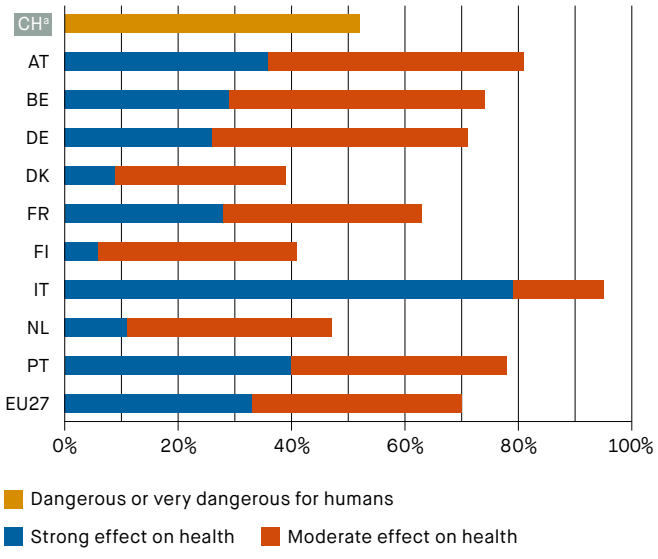
A study carried out in the Basel region between May 2010 and April 2012 found that exposure to high-frequency radiation in public areas increased by an average of 25% per year in the study period (→ *Swiss TPH 2013*). This increase is due to both the rise in mobile phone use and higher emissions from mobile phone base stations. The results match the observed rapid growth in the volumes of data transmitted via mobile communications (→ ***G I.11***).

Impacts

Electrosmog has a varying impact on living organisms, depending on the frequency involved. Very strong low-frequency radiation has been scientifically shown to stimulate nerves and muscles. Other

View beyond the borders

G II.17.2 Feared health risks from mobile phone antennae, 2010



[a] Based on the SFO's Omnibus survey of 2011 on the topic "Environmental quality and environmental behaviour".
Sources: EUROBAROMETER; FSO

According to a survey carried out in 2010, 33% of the population in the EU region fear that radiation from mobile phone antennae can have a strong impact on human health. A further 37% consider the influence on health to be moderate or small. The corresponding risk perception within Europe varies considerably: whereas the fear of the associated health risks is generally rather high in southern European countries, people in northern Europe appear to be considerably less concerned about the possible impacts of mobile telephony radiation. According to similar survey carried out in 2011, a good half of the population in Switzerland views radiation from mobile phone antennae as very dangerous or dangerous (→ *FSO 2012c*).

Switzerland is one of the few countries that has adopted a clear precautionary approach to electrosmog by defining installation limit values.

studies have shown that strong high-frequency radiation causes tissue to heat up.

Effects can also be detected for weak radiation intensity. For example, weak high-frequency radiation can alter electric brain activity and influence brain metabolism and blood flow. Whether these effects have an impact on health is still unclear.

According to the studies carried out up to now, short- to medium-term health impacts should not be expected from exposure to weak non-ionising radiation. There is no definitive answer, however, concerning the impacts of long-term exposure. For example, it is suspected that weak low-frequency radiation increases the risk of leukaemia in children. The World Health Organisation (WHO) has classified both low-frequency and high-frequency radiation as possibly carcinogenic to humans. In addition, some people firmly believe that they suffer from impaired well-being and health impacts due to very weak radiation. Ways of helping so-called electrosensitive persons are only beginning to emerge.

Reliable data are needed to monitor the temporal and spatial development of radiation exposure and identify possible health impacts. The form that such monitoring could take has been developed in a strategy and feasibility study (→ *FSM 2012*).

Measures

International recommendations on ambient limit values exist to prevent scientifically proven damage to health from electrosmog. Switzerland adopted these limit values in its Ordinance on Protection from Non-Ionising Radiation (ONIR).[1] Furthermore, the Federal Council imposed stricter installation limit values in this ordinance as a precautionary measure. These values are intended to ensure that exposure is kept as low as possible in locations where people spend time regularly and for extended periods (e.g. in homes, offices and schools). This will help to reduce the risk of possible, as yet unidentified, impacts on health.

The federal authorities base the definition of the installation limit values on the precautionary principle enshrined in the Environmental Protection Act (EPA):[2] radiation levels should be limited as much as technology and operating conditions allow, provided that this is economically acceptable. Because major gaps still exist in our knowledge about the health impacts of long-term exposure to weak non-ionising radiation, the adopted protective strategy should be pursued consistently.

1 Ordinance of 23 December 1999 relating to Protection from Non-Ionising Radiation (Verordnung über den Schutz vor nichtionisierender Strahlung, NISV), SR 814.710.

2 Federal Act of 7 October 1983 on the Protection of the Environment (Umweltschutzgesetz, USG), SR 814.01.

18 Overview of pollution types

Production, consumption, energy, transport, built-up areas and agriculture pollute the environment in different ways. Greenhouse gas emissions, increasing land-use, unsuitable spatial development, and the contamination of the environmental compartments with micropollutants, fertilisers, nitrogen and particulate matter have a particularly serious effect.

Who influences the environment and how? The following table specifies the most important types of environmental pollution in Switzerland and shows how human activities contribute to them.

Legend

The keywords in the table specify the influence of a human activity on a specific environmental field. For example, if we look at the effect of transport on soil, we see that increasing traffic volumes have an impact on soil through increased land use (intersection transport – soil). The impacts are explained in greater detail in the chapter on soil.

Definition of activities

The activity 'Production' covers industrial and service companies in Switzerland and their direct influence on the environment. The operations in the agricultural sector are taken into account separately under 'Agriculture'. 'Consumption' includes all impacts that arise from using products, services and natural resources in Switzerland. This includes the following: living (including heating, electricity, hot water, wastewater treatment and waste disposal), food, mobility behaviour, sport and leisure. 'Energy' refers to the production of energy. 'Transport' includes both means of transport (cars, trucks, railway etc.) and infrastructure (roads, rail networks etc.). 'Built-up areas' mainly refers to spatial land uses, e.g. for residential and work purposes and for leisure activities (green spaces, city parks etc.).

The selection of terms listed in the table is not exhaustive, but reflects the most important impacts mentioned in the thematic chapters. The keywords also indicate impacts that can be counteracted by specific measures. The terms in brackets are factors that have an indirect influence.

F II.18 Overview of pollution types

Human activities

Environmental topics	II.2 Production	II.3 Consumption	II.4 Energy	II.5 Transport	II.6 Built-up areas	II.7 Agriculture
II.8 Climate	→ CO_2 → VOC → Synthetic greenhouse gases	→ CO_2	→ CO_2 → Soot particles	→ CO_2 → Soot particles		→ Methane → Nitrous oxide → CO_2
II.9 Biodiversity	→ Global trade (invasive species, harmful organisms)	→ Eating habits → Leisure activities	→ Hydropower generation → Wind energy plants	→ Land use → Fragmentation → Sealing → Nitrogen oxides (ozone, over-fertilisation)	→ Land use → Sealing → Light emissions	→ Fertilisers → Biocides / plant protection products → Rational management (monocultures) → Ammonia (over-fertilisation)
II.10 Air	→ VOC (ozone, secondary particulate matter) → Particulate matter (health) → Nitrogen oxides (ozone, over-fertilisation)	→ VOC (ozone, secondary particulate matter) → Particulate matter (health) → Nitrogen oxides (ozone, over-fertilisation)	→ Nitrogen oxides (ozone, over-fertilisation) → Particulate matter (health)	→ Nitrogen oxides (ozone, over-fertilisation) → Particulate matter (health)		→ Ammonia (over-fertilisation), secondary particulate matter) → Particulate matter (health) → Nitrogen oxides (ozone, over-fertilisation)
II.11 Water		→ Micropollutants	→ Hydropower generation → Cooling water		→ Biocides → Hydraulic engineering structures	→ Fertilisers → Biocides / plant protection products → Hydraulic engineering structures
II.12 Soil	→ Land use	→ Land use → Residential siting (commuting)		→ Land use → Nitrogen oxides (ozone, over-fertilisation)	→ Land use → Sealing → Compaction	→ Tillage (compaction, erosion) → Copper, zinc (pig fattening) → Ammonia (over-fertilisation)
II.13 Landscape		→ Leisure infrastructure → Residential siting (commuting)	→ Hydropower generation → Wind energy plants → Overhead power lines	→ Land use → Fragmentation	→ Land use → Urban sprawl → Sealing → Standardisation → Light emissions	→ Rational management (monocultures) → Abandonment of farming
II.14 Forest	→ Global trade (harmful organisms)	→ Leisure activities		→ Nitrogen oxides (ozone, over-fertilisation)		→ Ammonia (over-fertilisation)
II.15 Natural hazards	→ Unsuitable siting	→ Individual risk and protection behaviour	→ Unsuitable operating arrangements	→ Unsuitable transport planning → Sealing (runoff)	→ Unsuitable spatial planning → Unsuitable construction methods → Sealing (runoff)	→ Lack of space for water bodies
II.16 Noise		→ 24-hour society → Residential siting (commuting)	→ Wind energy plants	→ Road traffic → Railway traffic → Air traffic	→ Unsuitable spatial planning	
II.17 Electrosmog	→ Mobile radio antennaes	→ Use of radio applications	→ High voltage power lines			

19 Overview of environmental impacts

In its current state, Switzerland's environment is adversely affecting human health and well-being, has negative effects on the natural ecosystems, and can damage infrastructure.

The following table summarises the impacts described in the thematic chapters and allocates them to categories of damage. It also shows that different factors often cause damage within the same category. Most effects can not be directly traced to impacts that occur in a specific environmental sector as, in many cases, the end effect is due to a combination of impacts. For example, if people are injured due to a flood, many factors play a decisive role in the process: altered climate conditions can cause heavy rain while the compaction and sealing of the soil or engineering of riverbeds make places susceptible to flooding. When combined with individual risk behaviour, a flood event can result in injury to individuals.

People and their health are affected by environmental factors, such as air pollution, noise, pollutant contamination, radiation, and the loss of habitats and landscape quality. According to World Health Organisation estimates, 15 to 20% of deaths in Europe are attributable to harmful environmental factors (→ *EEA 2010*).

Although major progress has been made in Switzerland in protecting health against environmental pollution, the effect of particulate matter, ozone and noise, which cause a variety of diseases, remains unacceptable. The accumulation and interaction of pollutants in the human body, which may have long-term effects that have yet to be researched in detail, is a particular problem. These pollutants include endocrine disrupters and persistent organic pollutants (POP). The decomposition of these substances in the environment and their elimination from the human body are very slow processes. Decades after being banned, they can still be detected in the human body.

Factors such as clean air, peace and quiet, aesthetic landscape qualities, and the opportunity to take exercise and relax outdoors have a major influence on people's health and well-being.

The environmental impacts on ecosystems can be divided into two groups. Many impacts cause the loss of habitats in terms of surface area, while others reduce the quality of habitats and landscapes (e.g. nitrogen inputs from the air). This affects not only the diversity of species, the survival of their populations and their genetic resources, but also the capacity of ecosystems and biodiversity to adapt to changing environmental conditions (e.g. climate change). Even in very low concentrations, micropollutants (organic trace substances such as pharmaceutical substances, hormones and biocides) in water bodies can endanger fish health and reproduction.

When ecosystems come under pressure, the services they provide to people (e.g. protection against avalanches or flooding, clean drinking water, recreation, identification and many others) also become scarce (→ *FOEN 2011d*). This, in turn, has consequences for the people's well-being and can give rise to considerable costs.

Air pollution causes serious acid damage to the built infrastructure. Floods and debris flows damage the transport infrastructure. In addition to the repair costs, property damage also leads to many indirect costs in areas dependent on the infrastructure. Adverse changes in the appearance of the landscape reduce the attractiveness of a location, which can lead to a decline in property values and major financial losses in the tourism sector. In areas where there is excessive noise, rents may be lower than expected – another example of a loss in value. The cost of treating the respiratory illnesses associated with air pollution is an example of the health costs that can arise from environmental impacts.

F II.19 Overview of environmental impacts

Environmental topics	Damage categories: People	Ecosystems	Infrastructure
II.8 Climate	✝ 🛏 ♥	🌳 🌲	🏠 📉
II.9 Biodiversity	🛏 ♥	🌳 🌲	
II.10 Air	✝ 🛏 ♥	🌳 🌲	🏠 📉
II.11 Water	♥	🌳 🌲	
II.12 Soil		🌳 🌲	📉
II.13 Landscape	♥	🌳 🌲	📉
II.14 Forest	♥	🌳 🌲	🏠
II.15 Natural hazards*	✝		🏠 📉
II.16 Noise	🛏 ♥		📉
II.17 Electrosmog	♥		📉

✝ Deaths · 🛏 Diseases · ♥ Reduced well-being · Loss of habitats and species · 🌳 Reduced habitat quality · 🏠 Material damage · 📉 Losses in value

* Floods, storms, avalanches, earthquakes, rockfall.

III Trends and outlook

The purpose of this part of the report is to estimate possible developments in the area of the environment for a time frame of 15 to 20 years. These future projections for current development trends, which are based on existing observations, are frequently supplemented by the presentation of possible alternative developments based on the introduction of certain measures. At international level, outlook studies carried out by the European Environment Agency (EEA), the Organisation for Economic Co-operation and Development (OECD) and the United Nations Environment Programme (UNEP) were taken into account in the assessments. These studies include an estimation of global mega trends and possible developments. Various outlook studies by the Federal Office for the Environment (FOEN) are available for individual environmental areas in Switzerland. Based on these literature evaluations and the available data, a brief overview of the global situation is presented and compared with the possible developments in Switzerland.

Environmental outlook 2030

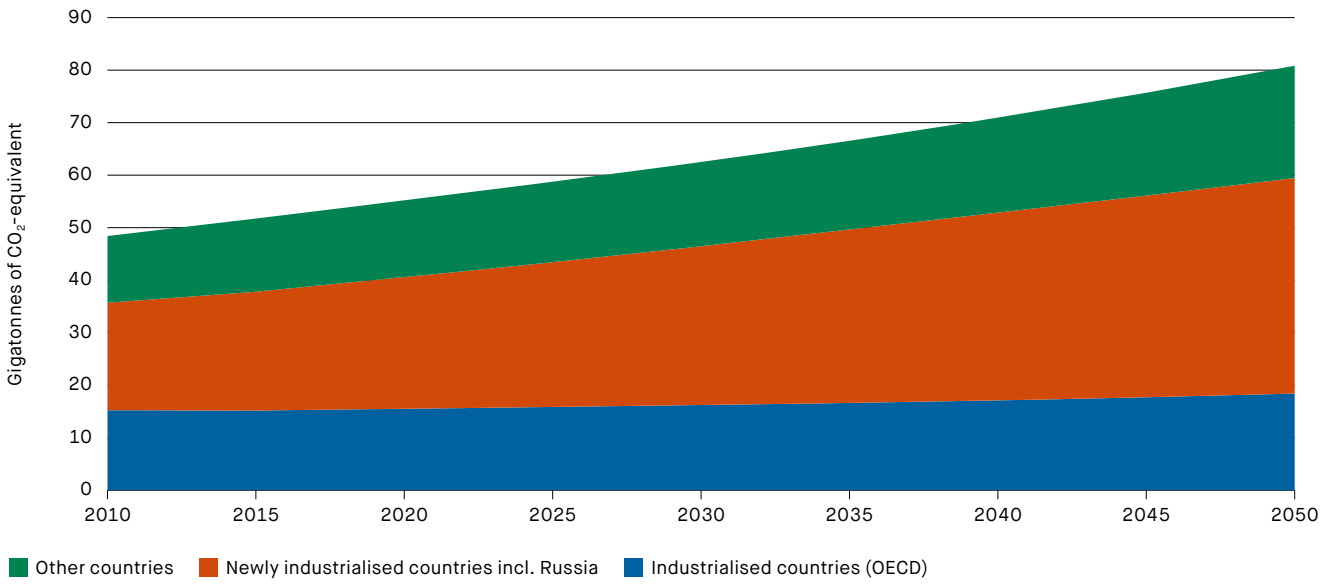
The future of Switzerland's environment is influenced by global trends and controlled by regional and local factors. Climate change is likely to make its presence felt more keenly in the Alpine region than in other parts of the world. Compared to other countries, however, Switzerland will not be seriously affected by water scarcity. The development of biodiversity in Switzerland is heavily dependent on the success of various measures. Although nitrogen pollution will probably decline, it is unlikely that the defined targets will be attained.

According to various studies, climate change, the quality and availability of water, biodiversity loss, and damage due to nitrogen compounds are among the major environmental problems of the 21st century (→ *OECD 2012; Rockström et al. 2009; UNEP 2012*). Reducing these environmental impacts to a tolerable level is a serious challenge because, so far, population and economic growth have been coupled with increasing resource consumption. By 2030, 8.3 billion people will populate the earth – an increase of 20% compared with 2010. The number of inhabitants in Switzerland is expected to grow by 10% to 8.7 million over the same period[1] (→ *FSO 2010*). The entire global economy should more or less double in size between 2010 and 2030. The countries that belong to the Organisation for Economic Cooperation and Development (OECD)[2] – which include Switzerland – can expect to grow economically by around 50%, which corresponds to an annual rate of around 2% (→ *OECD 2012*).

Climate

There are no indications at present that the observed increase in global greenhouse gas emissions will diminish considerably in the future. The OECD's basic scenario assumes that without climate-policy measures, the global emissions of greenhouse gases could grow by around 30% by 2030, and by two thirds of 2010 levels by 2050 (→ ***G III.1;*** *OECD 2012*). However, the scenarios produced by the Intergovernmental Panel on Climate Change (IPCC) also show that if the level of emissions is clearly reduced through decisive coordinated action, climate warming can be limited to a global average of less than 2°C compared with pre-industrial values (→ *IPCC 2013*).

G III.1 Development of greenhouse gas emissions by country group, 2010–2050 (OECD baseline)



Source: OECD

While halving global greenhouse gas emissions would considerably alleviate the consequences of climate change in the second half of the 21st century, the delayed reaction of the climate system means that the effect of these measures would be scarcely noticeable before 2030. Hence, the changes observed in the recent past point the direction for the coming two to three decades.

The average temperature in Switzerland has increased by 1.7°C (measurement period from 1864 to 2011). This temperature increase is over 50% higher than the 1.1°C rise recorded for continental areas in the northern hemisphere. Even if a considerable reduction in emissions is achieved so that global warming does not exceed 2°C – i.e. a reduction in global greenhouse gas emissions of at least 50% by 2050 compared with 1990 levels – a further increase in the temperatures of around 1.4°C may be expected here. This increase is almost equal to that recorded since temperature measurements began in Switzerland in 1864 (→ *CH2011 2011*).

In contrast to the temperature, it is not possible to identify any clear trend in relation to precipitation in Switzerland. Nevertheless, regional scenarios for Switzerland's climate development predict a noticeable decrease in the volume of summer precipitation towards the end of the 21st century. Depending on the success of global climate policy, it will decrease by 8% to 20% (→ *CH2011 2011*).

Climate change influences both the natural environment and many socially and economically important sectors in Switzerland. The effects can vary considerably due to local conditions (→ *CH2014 2014*):

→ Switzerland will have an abundance of water, also in the immediate future (2030). However, the availability and possible uses of water will change considerably at local and, in part, regional levels in the second half of the 21st century.

→ Glacier melt will accelerate in the 21st century. Over one third of the glacier volume that existed in the Swiss Alps in the year 2000 will have melted by 2030. Apart from a few exceptions in high-altitude areas, the glaciers will have disappeared completely by the end of the century.

→ Plant and animal species react to changes in temperature and precipitation according to their individual requirements. Scenario analyses indicate that, if climate change continues, currently common species of breeding birds and plants will gradually migrate to higher altitudes and their vacated habitats will be populated by new, thermophilic species.

→ With the rise in temperatures, the tree line is also shifting to higher altitudes. From the second half of the 21st century, changing precipitation should have an increasing impact on location conditions. Forests will grow less densely in dry locations, generate less biomass and relinquish their protective function to some extent. Spruce and beech will probably come under pressure at lower altitudes and be replaced by drought-resistant tree species like oak (→ *WSL 2013*).

→ The vegetation period will be extended by around 1.5 months on the Central Plateau by 2060, and by even more in the Alps and Pre-Alps (→ *METEOSWISS 2013*). This will provide more production options in the agricultural sector. In the long term, however, agriculture will have to adapt to the risks of rising temperatures and more frequent periods of drought. The Central Plateau, Valais and Ticino regions face a particular risk of greater economic losses due to low water levels and extreme drought (→ *FOEN 2012e*).

→ Up to 2030, any increase in the number of heatwaves will be negligible. In contrast, people will regularly have to deal with extended periods of very high temperatures in the second half of the 21st century, particularly in the densely populated urban agglomerations.

→ Higher minimum temperatures encourage the emergence and spread of new pathogens and their transmitters. The potential for new types of infectious diseases will increase as a result. Rising maximum temperatures are important in the context of food hygiene, as pathogens reproduce faster in water and in food at higher temperatures.

→ Climate change will have impacts on natural hazards. The potential for rockfall and boulder avalanches in the mountains is increasing because, with the rise of the long-standing zero-degree line and the retreat of the glaciers, a lot of loose material will be released and steep mountain slopes in high Alpine valleys may become unstable. More frequent and extensive damaging events are likely to occur in future due to floods and storms.

→ The heating energy requirement in 2030 should decline by approximately 5% compared to the year 2000 due to rising temperatures. A reduction of 15 to 25% may be expected (for any building that remains unchanged) until around the end of the century. An increase by a factor of two to eight may be expected in relation to electricity consumption for cooling, especially at lower altitudes and in densely populated locations. In absolute figures, the cooling energy requirement will remain small, however, compared to heating energy.

→ Switzerland has the highest skiing areas in the Alpine region. Therefore Swiss winter tourism is less vulnerable to the rise in the snowline than winter tourism in neighbouring countries. However, fewer new snow days are also expected at high altitudes. Hence, at altitudes above 2,500m, the number of new snow days up to the year 2060 should fall from around 100 today to some 80 (→ *METEOSWISS 2013*). In the medium term, numerous winter sport areas at lower altitudes in the Alps and Pre-Alps regions will be forced to offer alternative services. More frequent and longer periods of heat in the Mediterranean region could have a positive impact on summer tourism in Switzerland.

From a general perspective, up to 2030, climate change may be expected to have both positive (e.g. for agriculture and energy consumption) and negative (e.g. for natural hazards and biodiversity) effects in Switzerland. In the longer term, with the exception of energy consumption, the negative effects will clearly predominate (→ *CH2014 2014*).

Switzerland has the economic resources and technical expertise to adapt to the effects of climate change. With the action plan for the Federal Council's adaptation strategy, which was approved in spring 2014, the federal authorities have taken the first step towards implementing the necessary measures (→ *FOEN 2014e*).

Although many of the challenges arising in other regions of the world – for example, rising sea levels, water scarcity and drought, and natural hazards, such as flood disasters and tropical storms – do not affect Switzerland directly. Possible repercussions may be expected in the coming decades, for example, when global agricultural production and Switzerland's supply of important imported goods are limited or at times of regional conflict or increased immigration (→ *BK 2011*).

Water

Water is already a limited resource in many regions of the world. Population and economic growth and climate change are contributing to the fact that even more regions will face water scarcity problems in the future. In 2000, 1.6 billion people lived in areas with extensive water scarcity and, based on OECD estimates, this figure will have increased to 3.9 billion by 2050 (→ ***G III.2;*** *OECD 2012*).

Around 40% of global water consumption is virtual, i.e. the water is not consumed directly by the consumers but is hidden in agricultural products (80%) or industrial goods (20%). If the current global trend in eating habits towards greater meat consumption continues, and if measures for the more efficient use of water are not adopted, the demand for water could increase by 70% to 90% by 2050 (→ *World Water Assessment Programme 2009, UNW-DPAC 2011*).

As a country that is highly dependent on imports, Switzerland has a vital interest in encouraging the careful use of water and in identifying viable solutions for dealing with increasing water scarcity at a global level.

In Switzerland itself, only around 5% of the volume of water that flows through the country each year is used. The country will also have sufficient water in the future. Temporary bottlenecks in the water supply have already occurred in some parts of Switzerland, however. In the process of climate change – when periods of heat and drought increase – more areas may be expected to be added to those, in which sufficient water is not always available to meet all requirements in all locations.

In addition, instances of low water levels and increased water temperatures in water bodies are likely to become more common in summer as the snow and ice cover in the Alps shrinks and longer periods arise with air temperatures above the currently normal levels. Increased evaporation will reduce the moisture available to vegetation in the soil.

These developments could give rise to more conflicts between different uses of water (habitats for animals and plants, drinking, process and fire-fighting water, food production, energy generation, cooling, shipping, tourism and recreation). Such situations can be alleviated through predictive planning and by measures to increase the security of supply.

Agriculture and industry will have to consider adapting current irrigation and cooling practices.

The quality of water bodies in most non-OECD countries will deteriorate in the decades to come due to nutrient inputs from agriculture and the lack of wastewater treatment. Polluted water is the most important cause of disease and death from environmental causes. Nitrogen and phosphorous inputs into water bodies are expected to more than double by 2030 compared to 2000. In contrast, excessive nitrogen and phosphorous levels from agriculture are declining in the OECD countries (→ *OECD 2012*).

Thanks to wastewater treatment plants (WTPs), water quality in Switzerland is now excellent. However, residues from pesticides, cosmetics, drugs and other endocrine disrupters continue to pose a challenge (→ *EAWAG 2012, FOEN 2009d*). Many of these substances reach water bodies where they can have a negative impact even in low concentrations. These micropollutants are particularly problematic in the most important drinking-water resource, the groundwater. However, they also pose a problem in surface waters where they harm aquatic organisms.

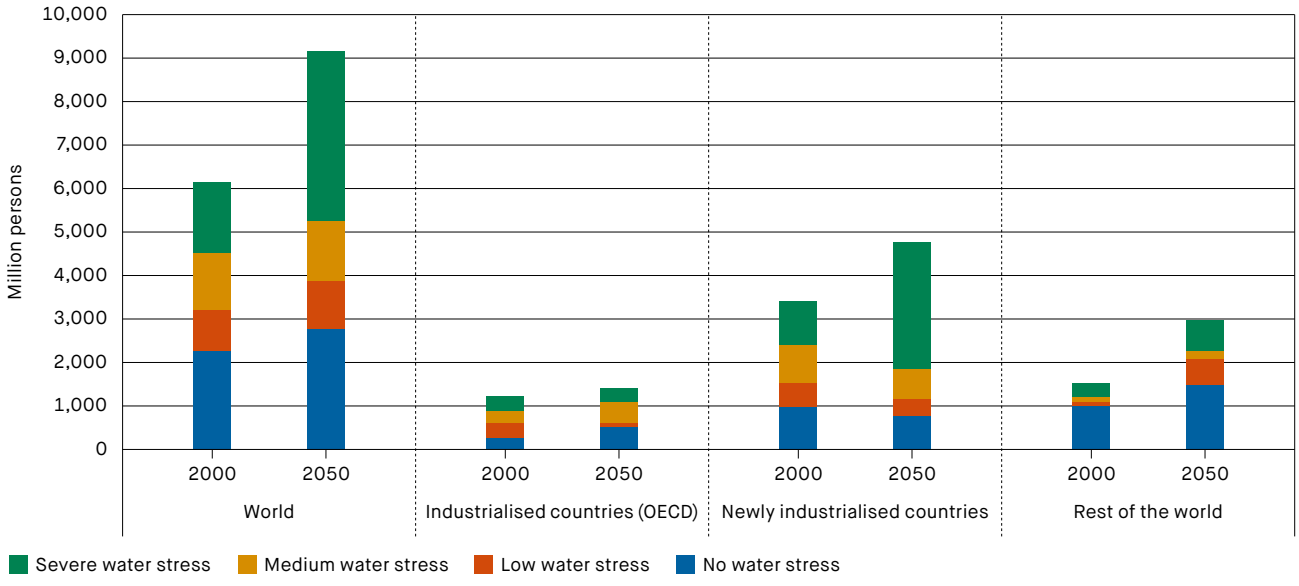
The targeted upgrading of around 100 WTPs with an additional processing stage, as is planned over the next 20 years in Switzerland, should guarantee that micropollutants will largely disappear from Swiss water bodies (→ ***Chapter II.11***). However, the upgrading cannot prevent the input of pollutants from agriculture, e.g. through the run-off of plant protection products into surface water bodies.

Increased precipitation and flooding, which may occur due to climate change, could pose an additional challenge to urban drainage systems. Today's sewage systems can only fulfil potential future requirements to a limited extent. Population growth and the increased sealing of land surfaces are contributing to the urban drainage systems reaching their capacity limits.

The water supply and disposal infrastructure must be optimised, maintained and financed to guarantee that a high level of service continues to be provided. Disproportionate dependencies on water resources and a lack of networking among water suppliers must be addressed to ensure that water is supplied, even in situations of scarcity (→ *FOEN 2014k*).

The ecological state of the structure of water bodies as a habitat for animals and plants in Switzerland is poor. It is anticipated that the situation will improve by 2030: for example, it is expected that rehabilitation projects, in which watercourses that were severely impaired over the past 150 years are restored, will continue. However, it is likely that this task, which will take several generations to

G III.2 Persons affected by water scarcity, comparison 2000/2050 (OECD baseline)



Source: OECD

carry out, will not be completed until the end of the 21st century. Moreover, under the current legislation, the negative impacts of hydropower production due to hydropeaking, disrupted bed load transport and barriers to fish migration can be expected to decline in the coming years, as they must be eliminated by the end of 2030.

Insufficient residual water volumes should also remain a problem until 2030 as many licences for hydropower plants will apply for decades beyond this deadline. Certain additional difficulties could arise due to the – albeit limited – planned expansion of hydropower production (→ *Federal Council 2013b*). The increase in the temperature of many water bodies due to climate change and the discharge of cooling water and wastewater are also growing problems.

Biodiversity

At 36%, the percentage of threatened species in Switzerland is considerably higher than the average for the OECD countries (→ *FOEN 2011b; OECD 2008*). Switzerland has failed to fulfil the target of reducing the loss of biodiversity significantly by 2010, which was set by the Biodiversity Convention in 2002. Accordingly, further losses must be expected (→ *FOEN 2010b; Lachat et al. 2010*). The contracting parties to the Biodiversity Convention – which include Switzerland – agreed on various measures to conserve biodiversity up to 2020, such as placing 17% of their national territories under protection.

If biodiversity is to remain rich and capable of responding to change (e.g. climate change), effectively conserved, interconnected and functional habitats are needed. An ecological infrastructure should be developed in Switzerland which guarantees that sufficient space is available for the long-term conservation of species and habitats. This is one of the ten objectives of the Swiss Biodiversity Strategy adopted by the Federal Council in 2012 (→ *FOEN 2012b*). To ensure the availability of a functional ecological infrastructure, new protected areas must be established and existing ones upgraded and connected to each other. Ecologically valuable agricultural and forestry areas, water bodies, built-up areas and areas along transport infrastructure are suitable for use as connection areas.

The OECD assumes that biodiversity will decline globally. This is based on an estimate of the average species populations compared with the original, undisturbed state of the ecosystems. The OECD expects that 6.7% of global biodiversity will be lost by 2030 and as much as 10.5% by 2050 (→ ***G III.3***). At 19.2%, the biggest losses are expected in the Japan/South Korea region, followed by Europe at 16.8%.

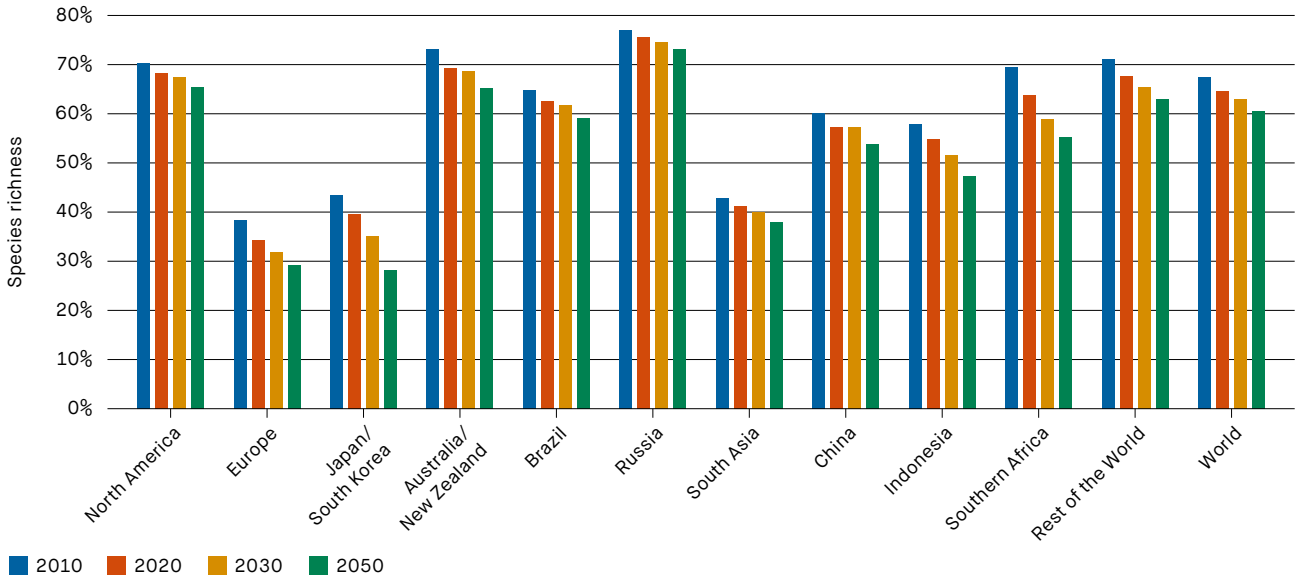
Most of the biodiversity losses up to now are the result of changes in land use (e.g. conversion of natural ecosystems for food production) and the expansion of human infrastructure and activities. These two factors will remain dominant influences in the future. According to forecasts for the OECD countries, climate change has been assuming increasing importance as a biodiversity-limiting factor since 2010 (→ *OECD 2012*).

Numerous species in Switzerland are extending their ranges to higher altitudes due to rising temperatures. A shift of 15m to 30m per decade has been observed for plants and one of up to 100m for birds. Accordingly, the number of species in higher altitudes should increase temporarily. In the longer term it may be expected that species previously found in these locations will be displaced and could become regionally extinct (→ *Vittoz et al. 2013*). The shifting of the vegetation zones will result in the alpine and nival zones shrinking: with 3.3°C warming (which is in the potential range if emissions increase unchecked to the mid-21st century), the alpine zone would decline by 64% and the nival zone by as much as 81% (→ *Theurillat und Guisan 2001*). This would endanger species, for which Switzerland has a particular responsibility due to its location in the Alpine Arc (→ *Lachat et al. 2010*).

As is the case elsewhere in central Europe, Switzerland has hardly any primeval forests. Hence forest management has a crucial influence on forest biodiversity. In contrast to other countries, artificial or very unnatural forests are comparatively rare in Switzerland and regeneration is natural in 55% of forest area (→ *WSL 2012*). In addition, the adopted forest policy measures ensure that, due to forest reserves, the proportion of forests at mature stages of development will rise by 2020 along with the proportion of valuable deadwood (→ ***Chapter II.9***). At the same time, it is expected that wood harvesting will increase to 2020, making well-lit forests with their typical light-loving endangered species more common again.

The Swiss Biodiversity Strategy, which was approved by the Federal Council in 2012, actively

G III.3 Remaining species diversity in terrestrial ecosystems by region, 2010–2050 (OECD baseline)



Quelle: OECD

promotes the sustainable use of biodiversity. In addition to improving existing deficits in forests, the Strategy also includes for measures in agriculture (and in hunting, fishing, tourism and other forest-related activities) (→ *FOEN 2012b*). Overall, it may be assumed that biodiversity in Swiss forests is developing more positively than in the OECD scenario.

As is the case with the forests, management is the crucial factor when it comes to biodiversity in agricultural areas. The agricultural policy in force until a few years ago made no provision for conserving biodiversity on productive cultivated land (→ *Federal Council 2009*). For example, using scenarios it has been calculated that under the 2011 Agriculture Policy, which has now been replaced, up to one quarter of species-rich lands would have been lost within a period of 10 years in mountain regions (→ *Stöcklin et al. 2007*). With the Agriculture Policy 2014–2017 new incentives have been created for the qualitative upgrading of biodiversity promotion areas, and for closing the gaps that exist in the ecological infrastructure. The Action Plan for the Biodiversity Strategy, which is currently under development, contains measures that support these efforts.

The OECD scenario takes very limited account of measures to improve the ecological quality of agricultural areas. Accordingly, in this scenario the influence of agriculture on the development of biodiversity is underestimated compared to that of the climate, forest management and other factors. Any decrease in the years to come in the nitrogen inputs that currently impair the biodiversity of many near-natural ecosystems in Switzerland will be insufficient.

The development and expansion of built-up areas and the fragmentation of habitats should have a greater influence on biodiversity in densely populated Switzerland than in many other countries. Whereas the populations of OECD countries are expected to rise by 7% up to 2030, Switzerland's population is expected to increase by 10% to 8.7 million. If the rapid increase in the space required for residential purposes and the equally increasing space requirement for (transport) infrastructure continue, the considerable growth in settlement and urban areas will also continue.

Biodiversity development is largely dependent on whether ecological infrastructure in the form of protected and connection areas can be established, and on urban areas being upgraded in such a way that the state of biodiversity in built-up areas improves (→ ***Chapter II.13***). Compensation areas along the edges of roads and railway lines can encourage species that do not require much space to establish themselves, and wildlife corridors can reduce the negative impacts of transport routes. Encouraging

biodiversity in built-up areas is an objective of the Swiss Biodiversity Strategy in its own right (→ ***Chapter II.9***).

Invasive alien species and changes in aquatic ecosystems due to hydropower production and hydraulic engineering structures also put pressure on biodiversity. The OECD scenarios do not take these two factors into account. For Switzerland, it must be assumed that invasive alien species will grow in number and cause more problems as the movement of persons and goods increases, and that, due to climate change, environmental conditions will become more favourable for many of these species (→ *Lachat et al. 2010*).

Nitrogen

Nitrogen is a key component for all forms of life. Plants use it to produce proteins which, in turn, are an essential component of human and animal nutrition. Nitrogen is also contained in excrement, which – used as fertiliser – contributes to closing the natural material cycle. Nitrogen fertilisers for plants are produced from atmospheric nitrogen using fossil fuels. Thanks to the use of these low-cost fertilisers, it has been possible to increase the yields from agricultural cultivation exponentially and, consequently, food and animal feed production. However, as nitrogen fertiliser has been produced industrially in large volumes, and because burning motor fuel and combustibles releases nitrogen into the atmosphere, the volume of reactive nitrogen compounds[3] has more than doubled globally over the course of the 20th century (→ *UNEP 2012*). As a result nitrogen has become a critical factor in many instances of environmental pollution.

Nitrogen compounds spread both through the air and when dissolved in water. As nitrogen oxides (NO_X), they are precursors of health-damaging particulate matter and ozone, as nitrates they pollute the groundwater, and as nitrous oxide they heat the climate, contribute to the acidification of forest soil, and over-fertilise ecosystems that are of particular value for biodiversity, e.g. raised bogs.

The OECD assumes that the pollution of the environment with nitrogen from urban wastewater, agriculture and other sources is increasing in most regions of the world (→ ***G III.4;*** *OECD 2012*). As a result, the over-fertilisation of ecosystems will also continue to increase and biodiversity will decline, particularly in aquatic habitats.

The OECD expects nitrogen compounds from agriculture to increase by around 20% by 2050. By 2030, the world's rivers will discharge an average of around 4% more nitrogen compounds than today. However, a decrease of 5% is expected in OECD countries, while an increase of 11% is expected in newly industrialised countries (→ *OECD 2012*).

According to a base case scenario, nitrogen flows in Switzerland should generally decline from 2005 to 2020, but further increases in specific sectors may also be expected (→ *FOEN 2013l*):

- Nitrogen inputs in the agricultural and forestry sectors combined will decline by around 12,000 tonnes or 7% by 2020. It is expected that imports of mineral fertilisers and nitrogen deposits from the air will continue to fall. Conversely, it is assumed that animal feed imports will increase, causing an accompanying rise in nitrogen inputs in agriculture. Hence the nitrogen outputs from agriculture will only fall by around 6,000 tonnes.

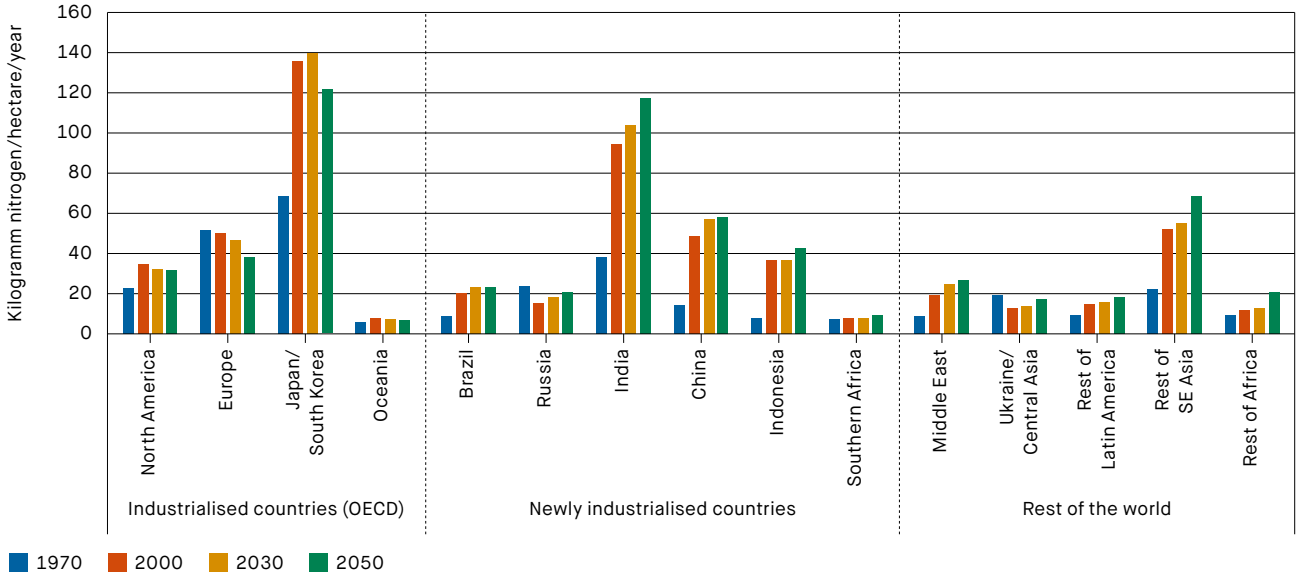
- A decline of 22,000 tonnes in nitrogen inputs is expected in the other environmental compartments (soil outside agricultural and forest areas, air, surface water bodies, groundwater), above all because the emissions in the air from traffic will fall by an estimated 36%, and those from agriculture by 6%. This will reduce nitrogen deposits in the soil, and the leaching of nitrogen from the soil will also decline.

- Overall, only minor changes in the nitrogen flows from the manufacture and use of products are expected. The increase in nitrogen imports through foodstuffs will constitute an exception here.

- Due to further population growth, nitrogen inputs into wastewater are expected to increase by 5,000 tonnes or 5% in the period from 2005 to 2020. Thanks to improvements in wastewater treatment, it will, however, be possible to keep inputs into water bodies constant.

According to the foregoing scenario, despite having achieved some reductions by 2020, Switzerland will clearly fail to meet all of the national and internationally binding targets. If all of the measures in the Air Pollution Control Strategy and in the new energy and climate policy are implemented as planned, the

G III.4 Nitrogen surplus in agriculture in selected countries and regions, 1970–2050 (OECD baseline scenario)



Source: OECD

aim of complying with the ambient air quality standard for nitrogen dioxide may be achieved.

The ongoing activities being carried out in association with the sectoral policies for energy, climate, air pollution control, waters protection, and agriculture are having a beneficial impact on the nitrogen cycle. Conflicts could, however, arise with the new combined gas and steam power plants and with the increased use of biomass as an energy source.

Conclusions

The impact of climate change on Switzerland will probably be above average, and the negative effects will clearly outweigh the positive in the long term. Due to its economic strength, Switzerland has comparatively effective resources at its disposal which will enable it to adapt and overcome the consequences of climate change for society. At the same time, through its commitment and involvement at international level, Switzerland helps to protect the global environment. This is also in its own interest: environmental pollution does not stop at borders and, due to its global economic links, Switzerland is also dependent on foreign resources.

The outlook for water is comparatively favourable in Switzerland. However, virtual water consumption, particularly in imported goods, is considerable. Like climate change, water scarcity abroad can result in humanitarian crises, the effects of which will also be clearly felt here in Switzerland.

In contrast to the case of climate change, Switzerland appears to be largely capable of controlling future developments in biodiversity on its own. With its comprehensive package of measures, the Action Plan for the Swiss Biodiversity Strategy will show how Switzerland can meet the objectives of the Strategy. The state of open land, forests and water bodies is strongly influenced by the ways in which land is used in the agriculture, the forestry and the water sectors. Switzerland's comparatively high population density compared with other countries means that built up-areas and transport routes are a key factor affecting biodiversity.

As in most countries, nitrogen flows in Switzerland are strongly influenced by inputs from agriculture. Although the target values are within reach in some areas, effective measures have yet to be taken in others.

Switzerland's economic strength increases its scope for action in managing major ecological challenges. At the same time, however, its economic prosperity has a dominating influence on climate, water consumption, biodiversity, the nitrogen cycle and other environment-relevant areas. Switzerland is setting

the course for the future state of the environment through the political decisions being made today and the measures being introduced now. What is important here is to make the most of the global scope for action (e.g. for binding greenhouse gas reduction targets) while also implementing measures at national and local levels (e.g. for conserving and upgrading natural habitats and adopting more environmentally-friendly forms of management). In addition, a forward-looking and comprehensive approach to natural resource management is becoming increasingly important.

1 "Intermediate" scenario according to FSO 2010 (reference scenario A-00-2010).

2 Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Israel, Italy, Japan, Luxemburg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Sweden, Switzerland, Slovakia, Slovenia, South Korea, Spain, Turkey, United Kingdom, USA.

3 Excluding atmospheric nitrogen (N_2).

Acronyms

ARE
Federal Office for Spatial Development (since 2000)

ART
Agroscope Reckenholz-Tänikon Research Station

BK
Federal Chancellery

BWO
Federal Office for Housing

CLRTAP
Convention on Long-Range Transboundary Air Pollution

DETEC
Department of the Environment, Transport, Energy and Communications

EAWAG
Swiss Federal Institute of Aquatic Science and Technology

EEA
European Environment Agency

EMPA
Swiss Federal Laboratories for Materials Science and Technology

EU
European Union

FAO
Food and Agriculture Organization of the United Nations

FEDRO
Federal Roads Office

FOAG
Federal Office for Agriculture

FOEN
Federal Office for the Environment (since 2006)

FOSP
Federal Office for Spatial Development (ARE since 2000)

FSO
Federal Statistical Office

ILNM
Federal Inventory of Landscapes and Natural Monuments of National Importance

IPCC
Intergovernmental Panel on Climate Change

METEOSWISS
Federal Office of Meteorology and Climatology

NAQUA
National Groundwater Monitoring Network

NFI
Swiss National Forest Inventory

OECD
Organisation for Economic Co-operation and Development

OFCOM
Federal Office of Communications

SAEFL
Swiss Agency for the Environment, Forests and Landscape (FOEN since 2006)

SFOE
Swiss Federal Office of Energy

SLF
Institute for Snow and Avalanche Research

Swiss TPH
Swiss Tropical and Public Health Institute

UN
United Nations

UNECE
United Nations Economic Commission for Europe

UNEP
United Nations Environment Programme

UNESCO
United Nations Educational, Scientific and Cultural Organization

WHO
World Health Organisation

WSL
Swiss Federal Institute for Forest, Snow and Landscape Research

WTO
World Trade Organization

WWF
World Wide Fund For Nature

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Glossary

Alien species

Non-native animal (neozoan) or plant (neophyte) species introduced intentionally or unintentionally by humans after 1492. An alien species is defined as an invasive alien species if it reproduces intensively and spreads at the expense of other organisms.

Biodiversity

The diversity and variability of living organisms and ecological structures. Biodiversity encompasses three levels: species diversity (animal, plant, fungal and bacterial species), habitat diversity (ecosystems, such as forests and surface water bodies) and the genetic diversity found within individual species (e.g. subspecies, varieties and breeds).

Biosphere

All of the earth's ecosystems, including organisms and their habitats. The biosphere includes all parts of the atmosphere, hydrosphere and lithosphere, in which organisms live.

Buildings Programme

The federal and cantonal Buildings Programme promotes energy-saving renovation measures for buildings and investment in renewable energies, waste heat recovery, and the optimisation of building services technology. The Buildings Programme makes a significant contribution to the fulfilment of Switzerland's climate objectives.

Carbon sink

Through photosynthesis, trees remove CO_2 from the air, convert it and store it for extended periods in wood. The sink effect – the balance of carbon stored and released by biomass – is influenced by agricultural and forest management activities, and can contribute to the offsetting of CO_2 emissions.

CO_2-equivalent

Unit describing the amount of global warming that may be caused by a given type and volume of greenhouse gas using the functionally equivalent amount or concentration of carbon dioxide (CO_2) as a reference. To ensure better comparability, greenhouse gas emissions other than CO_2 (CH_4, N_2O, HFCs, PFCs and SF_6) are converted into CO_2-equivalents according to their global warming potential (GWP). One kilogramme of CH_4 corresponds to 21kg CO_2, and one kilogramme of N_2O is equivalent to 310kg CO_2.

Combustible

A material which, with the input of energy and in the presence of oxygen (oxidant), reacts chemically with the oxygen and thereby releases heat.

Contaminated site

Polluted site created by a facility, accident or landfill that has been proven to cause harmful or noxious impacts on the environment, or one that risks causing such impacts in the future.

Deadwood

Dead trees or components of trees. Deadwood is a characteristic feature of natural forests. It provides a habitat and food source for numerous organisms and is an important component of the forest ecosystem.

Decoupling

Arises if economic growth exceeds the growth in resource consumption or environmental pressure. Decoupling is relative if resource consumption or emissions remain constant or grow more slowly than the economy. If resource consumption or emissions decline and the economy grows nonetheless, decoupling is absolute. In the specific context of material consumption, this case is also referred to as the dematerialisation of the economy.

Ecological footprint

The ecological footprint is the area on Earth required to accommodate the lifestyle and living standard of a human being (with the continuation of today's production conditions) on a permanent basis. It includes the space required for the production of clothing and food and for the provision of energy, and also includes the disposal or recycling of the waste generated by individuals and the binding of the carbon dioxide released through their activities.

Eco-points

The 'ecological scarcity method' expresses environmental pollution using the eco-point as a unit. This method for evaluating the environmental impact of products in life cycle assessments aggregates the individual impacts (e.g. climate change, air and water pollution, and soil pollution) in a single parameter. It is based on legally defined targets for pollutant emissions and resource consumption, and measures the gaps between current emission val-

ues and these target values. The further the current status is from the target, the greater the number of points assigned to an emission.

Ecosystem

Network of interactions between a community of organisms (biocoenosis) and its environment (biotope). The latter is characterised by geological, pedological and atmospheric conditions. Components of an ecosystem form a network of interdependencies that enable life to be maintained and developed.

Ecosystem services

The term ecosystem service refers to the economic consideration of the benefits provided to humans by ecosystems. Examples of ecosystem services include the pollination of fruit blossoms by insects, the provision of freshwater and drinking water through the natural filtration of precipitation, the reproduction of fish populations as a source of food, and the provision of fresh air and an attractive environment for leisure and recreation.

Emission reduction certificates

Emission credits generated through emission reduction projects in developing countries and other industrialised states or economies in transition. Emission credits can be traded in the emissions trading system, a market-based climate policy instrument. This enables the reduction of greenhouse gas emissions wherever it is most cost-effective.

Endocrine disruptor

Substance that influences the hormone balance of organisms.

Energy carrier

Any substance from which energy can be generated, either directly or following conversion. A fossil energy carrier is a primary energy carrier formed from organic substances in the soil (mineral oil, natural gas, various hydrocarbons, coal etc.).

External costs

Costs incurred in production or consumption processes that are not borne by the generator of the costs.

GDP (gross domestic product)

Measure of the performance of a national economy over the course of a year. GDP measures the value of goods and services produced in the country, provided they are not consumed in the production of other goods and services – in other words so-called value added. GDP is calculated using either current prices or constant (i.e. real) prices for a given year. With constant prices, real economic development over time is represented without the influence of price changes.

GMO (genetically modified organism)

Organism (animal, plant, fungus, micro-organism) whose genetic material has been modified in a way that does not occur in nature through crossbreeding or natural recombination.

Green economy

A green economy is understood as an economy that takes the scarcity of finite resources and regenerative capacity of renewable resources into account, improves resource efficiency and increases the long-term competitiveness of the economy as a result.

Greenhouse effect

The greenhouse effect is a natural phenomenon. It is caused by various gases in the atmosphere (water vapour, carbon dioxide, methane, nitrous oxide etc.) that reradiate some of the heat radiation originating from the Earth back again. An increase in the concentration of such greenhouse gases causes the Earth's surface to heat up.

Greenhouse gas

Gaseous substance in the air that contributes to the greenhouse effect and can be either natural or anthropogenic (caused by human activity) in origin. The Kyoto Protocol regulates the following greenhouse gases or groups of gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). HFCs are used mainly as substitutes for chlorofluorocarbons (CFCs) – the latter, which are also greenhouse gases, are responsible for stratospheric ozone depletion and are regulated by the Montreal Protocol.

Hazardous waste

Waste whose environmentally sound disposal requires special technical and organisational measures due to its composition and chemical-physical or biological properties.

Heating fuel

see Combustible

Hydropeaking (surge and low flow)

Periodic change in the water regime of a water body. Surge refers to the artificially increased discharge that arises during the operation of hydroelectric turbines to satisfy peak demand. Surges are punctuated by phases of low flow during periods of low demand for electricity, i.e. usually at night and weekends.

Land-use statistics

As mandated by the Federal Council, the Federal Statistical Office (FSO) has produced a simplified picture of land use and land cover every twelve years since the 1980s. The results reflect, in a way, society's footprint on the landscape. To date, three nationwide surveys have been completed: the first (1979/85) was based on aerial photos taken from 1979 (Western Switzerland) to 1985, the second (1992/97) was based on aerial photos taken from 1992 (Western Switzerland) to 1997, and the third (2004/09) was based on aerial photos taken between 2004 and 2009. The results are published on the SFSO website (***www.bfs.admin.ch*** → Themen → Raum, Umwelt → Bodennutzung, -bedeckung [g, f]).

Limit value

Threshold value applied in the assessment of exposure to the harmful or noxious impacts of air pollution, noise, vibrations and radiation. It takes the impact of such exposure on particularly vulnerable groups, such as children, sick people, the elderly and pregnant women, into account.

Material cycle

In ecology, a material cycle refers to the periodic conversion of chemical compounds, in the course of which the original substance arises again following a series of chemical reactions. The term 'material' refers here to a substance, chemical element or chemical compound, e.g. iron, dioxins.

Motor fuel

Mixture of combustible hydrocarbons in liquid or gaseous form which, when combined with air, drives an internal combustion engine.

Ratification

Confirmation of the signature at the bottom of a document containing an agreement concluded with another state. The deposition of the instrument of ratification generally constitutes the definitive validation of an international treaty.

Recyclables

Recyclables are materials that can be re-used following their initial use, transformed into other products or broken down into raw materials. They can be re-used and are thus returned to the material cycle.

Renewable energies

Collective term for energy sources that are not based on finite raw materials and are available for an unlimited period on a human timescale. They include hydropower, solar energy, ambient heat, biomass, wind energy, the renewable fractions of solid wastes, and the energy extracted from sewage treatment plants.

Resource efficiency

Resource efficiency involves obtaining the maximum possible output (prosperity) through the minimum possible input of resources (including soil, energy, material, factors that could harm the environment etc.).

Surge

see Hydropeaking (surge and low flow)

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